RURAL WATER SUPPLY.

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I.

Introductory and General.

The absolute necessity of pure drinking water for the maintenance of health has recently attracted considerable attention. Nevertheless the importance of the subject is seldom fully realized in rural districts. Here the manner in which typhoid and other fevers, diptheria, diarrhœa, cholera and other zymotic diseases are transmitted by means of drinking water is but little understood. A denizen of the country will place implicit confidence in the time-honored household well, even if it be placed in close proximity to sources of pollution. That this confidence is generally misplaced can hardly be doubted by any one who gives the matter a thought. Our agricultural friends tell us that under-drains laid three feet below the surface will effectually drain some 10 yards on each side of it. How much more then must a well, say 15 feet deep, collect the soakage from a foldyard, cesspool, or other source of contamination near to which it may be situated.

That the danger is not an imaginary or theoretical one has been proved but too often.

Water may be clear and sparkling when fresh drawn and yet dangerous to the health. In fact sewage contamination frequently improves its appearance, and also its briskness to the palate. Fortunately the purity of water may be roughly tested in a very simple manner by any one who is willing to take a little trouble in the matter. If a few drops of a solution of permanganate of potash are poured into a test tube containing distilled, or otherwise pure water, the rosy hue of the solution will be retained. If, however, a sample of water seriously contaminated with organic impurity be experimented upon it will lose its color in a few minutes. Should the color remain for about two hours the sample may be passed as a fairly good drinking water.

In the country the usual sources from which a supply of water can be obtained are wells, springs, water courses, and rainfall. The quality of the water drawn from deep wells is usually good if they are protected from surface water by concrete or an iron casing. Water from surface soaked wells should be looked on with great suspicion unless situated at a great distance from any possible source of contamination, and in no case should it be used without preliminary testing.

Spring water is free from organic matter; the inorganic substances which it contains vary greatly.

Hardness in water is caused by the presence of either carbonate or sulphate of lime in solution. The former is to a great extent precipitated, turning the water milky by the addition of washing soda or by boiling, while the latter still remains in solution. Whether hard or soft, spring water leaves little to be desired for potable purposes. Softness or the reverse, in drinking water makes it suitable or unsuitable to different constitutions, while a change from one to the other will often prove temporarily disagreeable. For washing purposes soft water is to be preferred as much less soap is required; and hard curdy suds, useless for cleansing are only produced in hard water. When a spring is used as a source from which water is carried in buckets, it should invariably be protected, the latter being filled from an overflow spout or by a pump drawing from a covered storage tank; this last being particularly adapted to weak springs. The waste may be allowed to run into a shallow pool or trough for the benefit of cattle and horses. Fig. 1 shows a suitable reservoir and pump.

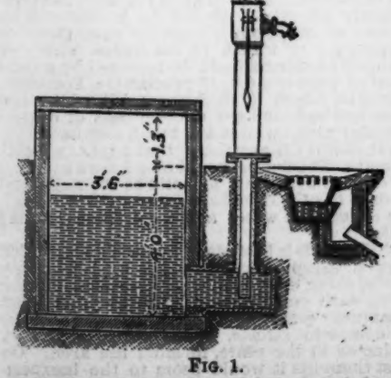


FIG. 1.

The water of rapidly running streams, although turbid during rains, is generally free from contamination, provided that no village, house, or farmstead is situated near its banks; but in purity these waters are not equal to that of large rivers. When filtered through gravel it gives a suitable water for domestic use, and being usually soft it is superior to most spring water for washing purposes.

In almost every case the engineer is controlled in his choice of the source from which a supply may be taken by local conditions, which commonly determine which is the most convenient in the few cases in which two or more springs or streams would appear to be available.

If the supply of water is found at a higher level than the place of consumption, gravity water-works are all that is required, and to this method we propose to devote our next section, leaving the consideration of the more difficult cases, in which the water must be raised to an elevation to be dealt with later.

The quantity of water to be supplied is a point on which the engineer's views usually differ from those of his customer. The latter generally has a very exaggerated idea of the amount consumed.

In large towns 15 to 25 gallons, and even 50 gallons in extravagant cases per head per day are used. This allowance includes that which is required for manufacturing purposes, which is by no means a small item.

A gentleman's country seat, with usual stables and grounds, should have a supply of 30 gallons per day for each inhabitant; while for cottages, 10 gallons per head is ample. For a farmstead 20 gallons should be allowed for each man and 6 gallons per working horse, 8 gallons per head of cattle, 1 gallon per sheep, if to be supplied.

GRAVITY WATER WORKS.

When a sufficient supply of water is found at a higher level than the point at which the service is required, it may be conducted thereto through tubes, pipes, or even in an open channel, by the force of gravity alone. The water is now purified and pumped by steam power into the modern distributing mains. Some of the wooden pipes made of elm, which supplied London in olden times, were thrown out from the excavations which were made for sewerage work in Oxford street a few years since.

The first practical question which suggests itself when a supply is proposed to be utilized, either by gravity or by pumping, is, whether the quantity is sufficient for the purpose. The amount required for consumption can be estimated from the data given above, and it only remains to test the springs. This may sometimes be done by catching the water in a bucket or measure of known capacity, and noting the time required to fill it. If a gallon measure divided in thousandths be available, the water flowing in 86.4 seconds, or say, 86½ seconds, being measured in it, the number of thousandths obtained will correspond with the number of gallons flowing in twenty-four hours. Generally, however, the only practical mode is by guaging the water over a tumbling bay or weir, of which we append an illustration.

Fig. 2 consists essentially of a dam constructed of boards with a notch cut in the upper edge, over or through which water is caused to flow during the operation of guaging.

The notch should be of sufficient width so that the water will not be over from four to six inches deep in running through. The manipulation is similar to that given in this article for the V notch guaging boards, with the exception that an ordinary rule, instead of one divided into tenths of an inch, should be used.

To find the quantity of water flowing. Suppose the notch to be 48 inches long and the depth measured at the stake to be 4½ inches, by referring to the table it will be seen that with 4½ inches over there will be 3.83 cubic feet of water for each inch in width of the weir, consequently 3.83×48=183.84 cubic feet per minute.

TABLE FOR RECTANGULAR WIER.

Head in Inches.	PARTS OF AN INCH.							
	0	⅛	¼	⅜	½	⅝	¾	⅞
		.01	.05	.09	.14	.20	.26	.33
1	.40	.47	.55	.65	.74	.83	.93	1.03
2	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9	10.86	11.08	11.31	11.45	11.77	12.00	12.23	12.47
10	12.71	13.05	13.19	13.43	13.67	13.93	14.16	14.42
11	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.64
12	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14	21.39	21.37	21.65	21.94	22.22	22.57	22.79	23.08
15	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21	38.65	39.00	35.34	39.69	40.04	40.39	40.73	41.09
22	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

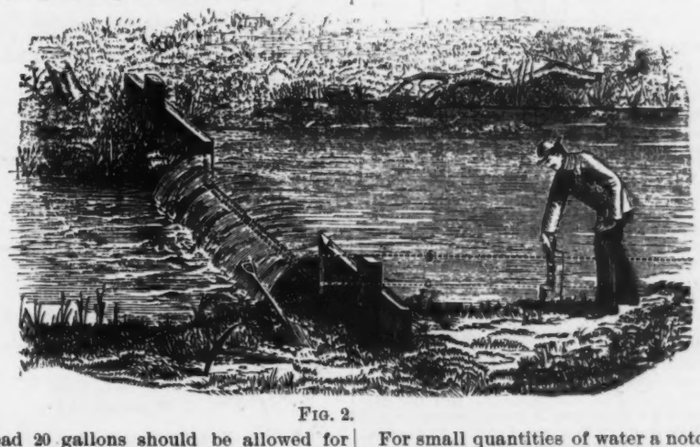


FIG. 2.

For small quantities of water a notch in the shape of a V, the point of which is a right angle, is more convenient than the rectangular notch, which is preferred when large volumes of water are to be dealt with. Such a board is represented in Fig. 3. It should be be constructed of ½ inch deal, and made of sufficient length to span the channel down which the water flows.

FIG. 3.

FIG. 4.

A convenient depth of notch is five inches, which is large enough to allow the passage of 110 gallons per minute. The edges of the notch should be chamfered off, so as to leave a thickness of one-sixteenth of an inch only in contact with the flowing water. The ends and bottom may, with advantage, also be chamfered for convenience in fixing. A peg with a step cut on one side, as shown in the annexed sketch, Fig. 4 should also be provided, care being taken that the height from the step to the top of the peg is not less than the vertical depth of the notch. A rule divided into inches and tenths completes the apparatus required.

The manipulation is as follows:—After choosing the sight for the dam, with a sharp spade cut grooves in each bank, and press the board down firmly into the grooves, so as to entirely stop the water, pressing soft clay around if necessary. Now measure the height from the surface of the water to the top of the board at each end, and press down the highest end until it is quite level. When the rising water approaches the bottom of the notch, fix the peg into the bed of the brook at a distance of three or four feet from the weir; and at the moment the water rises to the bottom of the

notch, drive the peg down until the step is exactly level with the point of the V. The water will now begin to flow through the notch, and will rise to a height that corresponds with the supply; so that by ascertaining the depth the water has risen since the peg was adjusted the quantity may be deduced. This required depth is now to be measured in inches and tenths, by putting the end of the rule on the step in the peg, and carefully noting the height of the water. The flow in gallons per minute, corresponding with the height, will be found in the following Table, calculated for the purpose by the writers:

TABLE FOR A RIGHT ANGLE V NOTCH.

Height in Inches.	Quantity in Gall. per Minute.	Height in Inches.	Quantity in Galls. per Minute.	Height in Inches.	Quantity in Galls. per Minute.
1.	1.90	2.4	16.98	3.8	53.57
1.1	2.42	2.5	18.18	3.9	57.17
1.2	3.00	2.6	20.75	4.	60.90
1.3	3.67	2.7	22.80	4.1	64.78
1.4	4.41	2.8	24.97	4.2	68.80
1.5	5.24	2.9	27.26	4.3	72.97
1.6	6.16	3.	29.67	4.4	77.29
1.7	7.17	3.1	32.20	4.5	81.75
1.8	8.27	3.2	34.86	4.6	86.37
1.9	9.47	3.3	37.65	4.7	91.14
2.	10.76	3.4	40.57	4.8	96.80
2.1	12.16	3.5	43.62	4.9	101.15
2.2	13.66	3.6	46.80	5.	106.39
2.3	15.27	3.7	50.12		

To shorten the length of time required for the operation, it is advisable to stop the notch with clay while the water is rising. Care should be taken that the stream be dammed up by the weir sufficiently to reduce it nearly to the condition of a still pond, and also that the water should have a clear fall from surface to surface not less in height than double the depth it runs over the notch. Where great accuracy is required, the weir should be adjusted by means of a spirit level, and the top of the peg made exactly level with the front of the V by means of the same instrument and a parallel straight edge of which the end is specially formed. The V board may with advantage be faced with thin sheet iron, and the notch cut through it; that through the wood being made of larger dimensions, so as to reduce the friction of the water to a minimum.

If gravity works appear to be practicable, it is first necessary to compare the guaging of the source (which should be taken during dry weather when the supply is at its lowest): with the estimated quantity required. If insufficient another supply must be searched for. The next question is that of the levels. In some cases it is perfectly evident by inspection, that there is ample fall from the sources to the point of delivery. In most cases, however, these should be carefully ascertained by means of a dumpy spirit level.

Whether gravity or pumping works are carried out a reservoir is required. This should contain a minimum of three day's supply if pumping is adopted, but one day's consumption will suffice in gravity work. The capacity in the former case will be much greater in certain instances, as will be explained hereafter.

Reservoirs sunk in the ground and arched or domed over keep the water clean, sweet, and pure. Open reservoirs, more particularly shallow ones, should in all cases be avoided. Circular cisterns are more economical in construction than rectangular ones when the size required is small. The circular form holds the greatest volume for a given length of the boundary wall, and has the further advantage that there is no tendency to alter its shape by the pressure of the surrounding soil as in other constructions. Their capacity in gallons per foot of depth may be calculated by multiplying the square of the diameter in feet by 4.8, or in round numbers by 5. The following table has been calculated in this manner.

Depth in Feet.	DIAMETER IN FEET.							
	5	6	7	8	9	10	11	12
5	6.00	8.65	11.75	15.35	19.45	24.00	29.00	34.55
6	7.50	10.35	14.10	18.40	23.30	28.80	34.85	41.45
7	8.75	12.10	16.46	21.50	27.20	33.60	40.65	48.40
8	10.00	13.80	18.80	24.55	31.10	38.40	46.45	55.30
9	11.50	15.60	21.15	27.65	35.00	43.20	52.25	62.20
10	12.00	17.30	23.50	30.70	38.90	48.00	58.00	69.10
11	13.50	19.00	25.85	33.80	41.75	52.80	63.90	76.00
12	15.00	20.73	28.20	36.85	46.65	57.60	69.70	82.95

The cost of a circular cistern sunk in average soil, say 12 feet diameter and 10 feet deep, containing nearly 7,000 gallons, may be roughly estimated at the sum of £16 or £17 ($85) laid in brick-work and cemented.

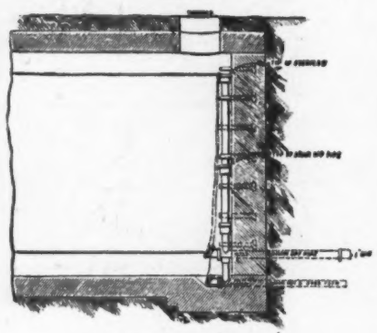
For some situations a rectangular tank, covered by an arched top, is more convenient. A section of 6 feet by 6 feet, the height being measured at the springing of the arch and invert respectively, has been occasionally adopted in our practice. This gives a capacity of about 225 gallons per foot of length. The required minimum length may then be obtained by dividing the quantity of gallons to be stored by 225. The best material for lining is brick-work set in Portland cement. After the completion of the brickwork, the whole of the interior should be carefully cemented with Portland cement, forming a lining. In rock or even sound chalk, the brick lining may frequently be dispensed with, if the covering of cement is carefully done, all crevices being cleared out and cemented up solid, and allowed to set before the remainder of the cement is commenced.

An American writer, the author of "Rural Hydraulics," advocates the use of circular cemented cisterns, without any brick-work at all, even in "clayey, loamy, or sandy soils." Although this would hardly be substantial enough to suit English ideas of what permanent work should be, it is well worth the attention of farmers and others whose length of tenure may be doubtful, and who may wish to construct works which will last a few years, at the least possible cost. As the remarks are eminently practical, I quote his directions for cistern building, in full—

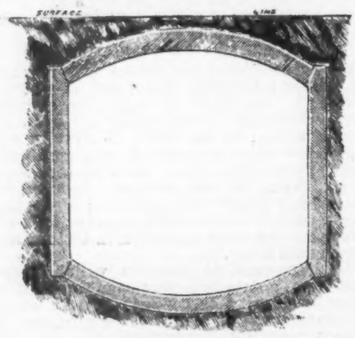
CEMENTED CISTERNS.

"Having picked out site, selected the spring most suitable, and having determined the manner of using it, we should dig into the hillside 6 to

FIG. 5.



Longitudinal Section.



Tranverse Section.

10 feet, and be more secure against rains, flooding muddy surface water into it, and also, if possible, to concentrate the streams, as in many cases springs which seem on the surface to be a mere marsh, but further in issues as a single stray stream. The streams having been gathered in one, should be carried in a temporary pipe beyond the outer edge of the cistern, and conducted to the side of the line where the digging for pipes is to be done. We will assume, for convenience, that the cistern is to be 10 feet in diameter at top, 8 at the bottom, and 8 feet deep, which would hold 120 barrels of water—a barrel being 31½ gallons. To lay out the cistern begin by driving a stake in the centre, taking a string 6 feet long, describing a circle (diameter 11 feet) remove the surface earth to a depth of 14 inches, edges plumb, driving the stake in as you proceed, the more readily to keep the centre, dig 9 inches farther, giving a batter of 2 to 3, against which the first course of arch brick is to be laid. Then use the string describing a circle of 10 feet, and taper the walls about a batter of 1 in 8 to the desired depth. If in loamy soil a batter of 1 in 8. If in stiff clay the walls may be nearly vertical; in sandy soil more batter must be given. If the earth dry through is disposed to slip, a lining of brick 4½ inches thick should be laid in cement. Usually the brick lining is unnecessary, for if one coat of cement can be put on well, there will be no danger of caving in.

"Should a small spring be tapped in digging for a cistern, a vertical branch from it to bottom of cistern, deep enough to lay a brick on end (leaving a smaller trench at the back of the cistern for the water to trickle down), should be laid, after the cement hardens; this opening may be closed permanently.

"Beginning at the lower end of the trench for pipe, dig the trench 30 to 40 inches deep (having if possible a regular grade) to within two feet of the cistern, then take a quarryman's drill, or pointed iron, and drive a horizontal hole through to the cistern, which may enter the cistern a few inches above the bottom. The

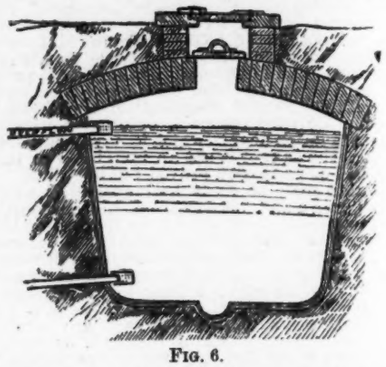


FIG. 6.

pipe may now be inserted and the earth tamped solid along the whole line, so as to leave the pipe undisturbed after the cement is applied to the cistern. The object in digging a hole horizontal through which to put the outlet pipe, is that the earth may be left solid, against which to cement. The cistern at spring need not be so large as the one described, where a hydraulic ram is to be placed below it, as the drive pipe of a hydraulic ram should have a continuous fall from the spring to ram, and to use all the water must enter bottom of cistern, arrange the inlet pipe from spring a trifle upon the arch, and the overflow pipe an inch or so below the arch, having its inner edge curved down about an inch.

Having the cement in readiness, apply a coarser coating to the earthen wall, first seeing that the wall is moist, at least so that a band may be made between the earth and the cistern;

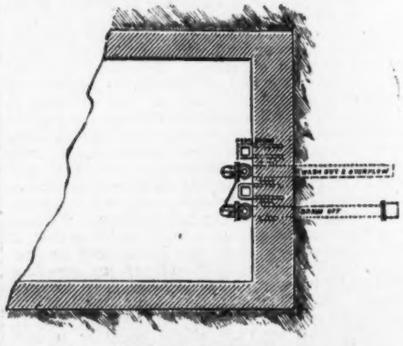


Fig. 7, Reservoir Plan.

beginning at the bottom of the cistern and working up, putting on a coat one or two inches in thickness. As soon as the cement has thoroughly set, which should be in two or three hours at most, apply another coat richer in cement, ¾ to 1 inch in thickness, which on properly setting should be followed by a third coat of pure cement (if procurable, Portland), perhaps ¼-inch in thickness. When this last coat has become hard another coat of cement applied with a whitewash brush may be put on, as that will fill any pores that might possibly remain. The floors should also have a covering of cement to make it as solid as the walls, and should be of a dish shaped form, to more readily collect the water and sand when cleaned out.

"The arch is best made by laying hard brick on end, using cement, or as is done in many cases, using only rich lime mortar, laying the brick each one slanting (so as to point to an imaginary centre 8 or 10 feet from the surface) in complete circles, each corner gradually rising as in the plate, forming the arch. On first thoughts it would seem to the inexperienced that the brick would fall in, but the cement, mortar, or even common stiff clay, with

which arches are frequently built, is sufficient to hold each brick in place till the segment of circle is completed, forming a complete arch in itself. As each course is completed, cover with a coat of cement, and over this spread earth, on which boards should be laid to prevent treading on any single brick while laying the remaining courses. Other circles are laid converging toward the same imaginary centre, where an opening only a little larger than a barrel is left. Procure a barrel (a flour barrel will answer the purpose), bore a hole in the centre of the bottom of the barrel, insert a pole reaching to the bottom of the cistern, which will allow the barrel to go only about one-third through the arch, the barrel is then traced from three or four fronts, by leaving tracks from the arch to it, and then completing the arch up the barrel with brick well laid in cement or mortar. Some persons build a framework or crib on which to place the brick and hold them till all is finished. Such is not necessary for brick but it is for stone; unless this arch is made very high in the centre. After the cement around the barrel has hardened, break and remove the barrel, then enter cistern, cement the inside of arch thoroughly, connect the spring permanently with the cistern. Build a wall around the hole, inserting four bolts, well painted, which will reach high enough to screw the trap-door frame into (preferably square), and a few inches larger, 12 or 15 inches high, up to which the earth may now be graded. A lid should be laid on the brick arch, and one for the top provided with lock and key, to prevent any accident or interference. A cistern so built should last for ages, and keep the water pure, clear, cool and free from vermin. Not until the cement has properly hardened, say a day or two after the last coat has been applied, should the water connection with the spring be made and the arch cemented."

Assuming that the construction of the tank has been sufficiently explained, the next points to be considered are the inlet and the outlet. The former may in gravity water works be ordinary drain tiles conducting the water direct from the spring without exposure to air or light. The outlet is of greater importance, and should fulfill the following conditions:—

1. That the supply should as far as practicable be taken from some point within three feet of the surface, so as to prevent the whole of the water being used without previous warning.

2. A wash-out and over-flow must also be provided.

Notes on the Construction and Equipment of Narrow-Gauge Railways.*

When asked by the committee to prepare a paper on narrow-gauge railways I consented; but, on looking over the subject, I find so little to be said, except as to cost, that will not apply equally well to any railway, that I will simply note a few points on their construction and equipment in general, and then give you, somewhat in detail, the various items of cost particularly applicable to narrow-gauge roads, hoping they may be at least interesting to the members of the association, though I do not think they will be particularly instructive to those whose experience is largely in railroad work.

Location.—The question of location I need not allude to accept to refer you to the able paper on the subject read by Mr. Hodgman at your last meeting. His treatment applies as well to roads of one gauge as another. I will say, however, that curves and grades on narrow-gauge roads are just as objectionable as on any road; although sharper curves may be used they should be avoided as much as possible.

Supposing our location to be completed and grades established we are ready to proceed with construction work; we will also suppose that the contract is drawn in proper form and the work let, subject to the proper specifications, as we are dealing more directly with the work of the engineer and the contractor.

Clearing and Grubbing.—The first work to be done is the clearing of the right of way and grubbing for the road bed; clearing should be done the full width of the right of way, whatever that may be, and all the logs, brush, and perishable matter be piled and burned, so as to be out of the way of the workmen as well as the contractor, as instances have been known where contractors have been tempted at least to use the logs, stumps, etc., lying along the right of way, for making the road-bed, which is not desirable except in special cases. The engineer should furnish the contractor, for use in clearing, notes of stations between which grubbing should be done, and width of grubbing so that he may do no useless work and may do grubbing in connection with clearing, as a standing tree is much easier to grub out than a stump. All stumps and grubs should be taken out where the sub-grade line is within 2 feet of the surface, also on all cuts. Where the fill exceeds 2 feet, low chopping will suffice, and in fills of 4 or more feet stumps of ordinary height are not very objectionable and may be left standing, except where they are very large and decayed, when they should be removed.

Cross-Sectioning.—Clearing and grubbing completed, the engineer is ready to do his cross-section work, which consists in putting in stakes every 100 feet, or oftener if the surface of the ground is uneven, which stakes are set, one in the center and one at the end of each slope. Each stake should be plainly marked on one side with the number of the station at which it stands, and on the other with the cut or fill to sub-grade at the point where it stands. They should be set uniformly, the center stakes exactly on the center line, with the station number facing the backward direction of the line, and the slope or side stakes set at right angles to the line even with the centre stakes, with cut or fill facing the line. On uneven ground plus or partial stations should be put in in the same manner as the regular stations, and the full station number should be put on each plus stake; thus a cross-section midway between stations 79 and 80 should be marked not simply +50 but 79+50. A little care in this direction will save a great deal of annoyance and time in subsequent work when stakes are knocked down by careless workmen and have to be replaced, possibly when the notes are not at hand. At every point where the grade and surface lines cross there should be set a *grade stake* marked 00 or grade; this should be done not only at the center but on each slope, and the plus station at which each occurs carefully noted.

Each cross-section should be carefully recorded in a cross-section book: the usual form being to place the center cut or fill in a central column, and left and right slopes in a column at left and right of the centre in the form of fractions, with the cut or fill as the numerator, and the distance out from the center line as the denominator, with their respective signs, plus for cut and minus for fill, thus:

L.	*C.*	*R.*
$\frac{-2.0}{9.0}$	+3.5	$\frac{+3.6}{13.4}$

showing a cut of 3.5 at the centre, a cut of 3.6, and a distance out of 13.4 on the right and a fill of 2.0 with a distance out of 9.0 on the left. These distances apply to a road-bed of 12 feet on fills and 16 in cuttings with a slope of 1½ to 1.

Experience has proved that there is no economy in building narrow road-beds. We commenced on the Port Huron and Northwestern Railway by making fills 8 feet at sub-grade and cuts 12 feet; then we widened banks to 9 feet; on our next work we made banks 10 feet and cuts 14, and now build banks 12 feet and cutting 16 feet, which is none too wide, and is found to be more economical in the end.

As I believe the papers which are read from time to time before this association are intended to be of practical use to the members, rather than finished literary or scientific productions, let me give what I consider the best method of doing cross-section work. I have noticed that beginners almost universally use the cumbrous method of figuring out each station by itself from the height of instrument and grade height, a tedious as well as unnecessary work. First, set your level firmly and in such a position as to command a good view of your work; bring it to a level and take a reading from the nearest bench mark which add to your bench height to give you the height of instrument. Now, from your cross-section book note the grade of the station at which you propose to commence your work. The difference between your instrument height and grade height will be the reading of your rod at that station held at grade and the difference between it and the actual reading at the point will be the cut or fill at that point.

Culverts.—During the process of locating and constructing the engineer has looked over his line and its contiguous territory closely, to determine the location, size and character of the necessary water-ways, and during his cross-section work has probably staked out his drains, culverts and bridges, made out his timber bills, and made provision for the timber and material for the various structures. In places where there is but a small area of surface drainage, and no danger of an accumulation of water, a small drain of sewer-pipe may be made, or in cases where cheapness of construction is necessary, which too often happens, a simple box or plank, spiked together, will answer where the embankment is light. Where there is any amount of water a culvert should be put in. On new work in new countries wood is almost entirely used, leaving the more expensive as well as more desireable stone and iron structures to be put in when the first have had their day, and the other can be brought to the spot by train, and the company have presumably more means to do work with.

Ordinary culverts are built of 12″×12″ timber; I used 10″×12″ on edge, the sticks laid one upon the other secured by dowel pins. The foundations are usually ordinary mudsills of flattened timber, sunk in the ground below the bottom of the waterway, to avoid undermining. The sills should be boxed down at the ends for a couple of inches to prevent the wall sticks from sliding in from the pressure of earth behind them.

The top wall piece of an open culvert should be 4 feet longer than the width of embankment of sub-grade, and each succeeding stick 3 feet longer than the one above it till the surface of the ground is reached. The walls should be braced against the thrust of the earth behind them by struts across from one wall to the other, usually dove-tailed into the wall sticks. Culverts should be laid out so as to have the top of the walls reached just to sub-grade; on these walls are laid the track-stringers, lying loose so as to be brought to the required line or shifted at any time. When open culverts are more than 8 feet wide they should be made with a bridge top, *i. e.*, with ties across the stringers. Box culverts are made as above described, but are covered with either plank or timber, and usually with the earth of the fill. Across small streams the ordinary pile bridge is the cheapest and best to build. Use white oak piles, not less than 10 inches in diameter at the small end, well driven; the usual plan has four piles in a bent, the bents from 12 to 16 feet apart (14 feet is a good distance), the piles sawed squarely off and the cap securely drift-bolted on top of the piles. Where the height does not exceed 12 or 15 feet the piles may answer as bents, and the track-stringers be laid directly on the caps; but where the height is greater there should be trestle-work on top of piles. Across larger streams, or where there is danger of freshets, ice, driftwood, or logs, there should be a clear span to leave the channel unobstructed; on navigable streams a draw-bridge becomes necessary. For ordinary trestle-work timber of the following sizes may be used: Caps 10×12, main posts 10×10, batter posts 8×10, stringers 7×14, lateral braces 6×6, sway braces 3×10, girts 6×6, ties 6×8, guard rail 6×6. These dimensions will suffice for narrow-gauge roads using engines of 18 to 20 tons weight; we have latterly built our bridges of the usual standard size.

Track-Laying.—In advance of track-laying, the engineer should carefully retrace his line along the grade and put in solid stakes for track centres; these stakes should not be less than 2 inches square, well driven, left 6 to 8 inches above the surface of the grade, and having a tack or nail showing the exact line on the stake. On tangents, center stakes 200 feet apart will suffice, but on curves they should be put in every 50 feet. Centers should be put on all culverts, and, at intervals of 10 to 20 feet, on all bridges. We will now suppose the centres in, the material all ready, our forces and construction trains at hand, and will proceed with work. First, we must load one train with the proper proportion of iron, ties, bolts, straps, spikes, and tools; the car for bolts, straps, spikes, etc., is usually the head car; then come the ties, then the iron. The train is backed out to the end of the iron, and when the track-laying force is ready as many rails and ties as will make a lorry load are thrown off, together with the necessary spikes, bolts, and straps, and the train pulls ahead out of the way. The lorry-men run their car back and load, say, 10 rails; above the rails, but placed so as to leave the rails loose, are loaded a sufficient number of ties for as much track as the rails will lay, and bolts, spikes, and straps enough for 10 joints. Then the lorry is run ahead to the end of the rails, where the men, standing in a row on each side, pass forward the necessary number of ties for a rail length, laying them evenly and properly spaced on the grade; being guided by a line stretched along the grade and a pole properly spaced; a large tie should always be selected for the joint. Next, on each side, the forward gang grasp the end of a rail and pull it forward, and, as the rear end drops from the lorry, it is caught by the rear gang and placed at the end of the rail in the track; then the forward end dropped to line; this is done on each side simultaneously; the lorry is then run ahead to the end of the two rails just laid, and the process repeated. While this work is going on another lorry load of iron and ties has been loaded and brought forward, the empty lorry tipped on its edge off the track

*[A paper read before the Michigan Association of Surveyors and Engineers Jan. 1884, by A. L. REED, Chief Engineer Port Huron & Northwestern Railroad, Port Huron.]

to allow the other to pass, which in its turn is unloaded and sent to the rear for another load. For laying light rails, three men at front and two at rear on each side, is force enough; for heavy iron more are necessary. As the iron and ties have been run out from the lorry a a pair of straps, with the necessary bolts, has been left at each joint, and two spikes dropped at each end of each tie.

Immediately in the rear of the lorry come the *strappers*, who quickly place the fish-plate, or whatever joint fastening may be used, on the joints, and bolt them to place, leaving the proper expansion at each joint; then come the *spikers*, working two together, the two on the line side ahead, spiking usually the joints, quarters and centers. Before the train is run upon the track each rail is spiked to the tie exactly to a line which a boy has previously chalked on it a certain distance from the end, measured by a short stick, so that when the rail is full spiked and lined, the line end of the ties are in a true and even line. The rail joints should be kept exactly opposite each other, except on curves, when joints should be opposite centers on narrow-gauge track, as it thus retains its aligment much better. Two spikers are also at work on the other side, using a gauge and quickly spiking the rail to place; each set of two spikers have with them a *nipper* or a man with a light iron bar and a block of wood, whose duty it is to hold the tie to the rail while being spiked. Spikes should be driven squarely into the ties so as to have a firm bearing against the rail, both on the side and head of the spike, and should be driven, not in the centre of the tie or exactly opposite on the sides of the rail, but one a little ahead of the other, but both inside spikes should be driven alike, *i. e.*, either ahead or back of the centre of the tie, as it prevents the tie from *rocking*, which it will do if spiked otherwise. As soon as the track is laid and spiked at the joints, quarters, and centers, the train may be run up and kept closely following the workmen. Behind the train come the back-spikers who complete the spiking, and then the *liners* who throw the track into line, when it is ready for the ballast train. Track-laying is often partially done by machinery by means of adjustable rollers, fastened to the sides of the car, on which the iron and ties are carried to the front along the side of the train; also by a lorry-car running on a track on the supply train. Each method has its advantages, especially where men are scarce.

Ballasting,—As soon as the track is laid the engineer should run his ballast grades, which should be marked by good stout stakes set at the side of the grade, at the foot of the slope of the ballast, opposite the center stakes, and driven so that the top of the stake should be as high as the top of the rail at final grade; stakes 200 feet apart on tangents and 50 feet on curves, the same as centers, will answer. The ballast train should consist of as many flats as can be conveniently used and handled, varying with the condition of the pit for loading, the capacity of the engine for hauling, and the force used to do the work. The most economical method, when a convenient pit of material is reached, is to lay a temporary track, (or what is better if it can be done, two tracks into it, by which much time will be saved in shifting trains), then load one train while the other is on the road. Unloading is most economically done under ordinary circumstances by means of a plow worked by a wire cable from the engine; then no time is lost by men riding back and forth between pit and unloading point, as the train force is sufficient to handle the plow, and the pit force can be adjusted so as to load while the train is making a trip. An estimate of the quantity of ballast to be used should be made so that the trainmen may make a proper distribution of it. Allowing the surface to be uniform at subgrade, the quantity of ballast to raise the track to final grade can be determined very closely and distributed accordingly, so, that when the surface is completed, very little or no ballast will remain unused.

In raising track it should first be lifted to final grade at each grade stake and securely packed; then, by use of sighting boards, the joints and centres between the two points are raised to the same grade, except on the vertical curve before alluded to when the intermediate points should be rounded to agree with the curve. On horizontal curves the outside rail should be raised; on 3-foot gauge we raise the outer rail $\frac{3}{4}$ inch for each degree of curvature up to 5°. All points of the track having been raised to the proper height, and the ballast shoveled in and well tamped the entire length of each tie, the track is ready for lining. A liner and three or more men with lining bars throw the track carefully to the exact centre as indicated by the tack head in the stake driven before track laying; then all parts of the track are thrown to correspond and the rails brought to a true line. One side (it is not essential which) should be taken as the line side, and all linings of ties, iron, or track be done on that side. Following the liners comes the finishers, who properly distribute what material may be left by the surfacing gang and give the required surface to the ballast, dress it up neatly, remove any ballast from the ditches in cuts, and gather up in shape for removing any surplus material. Different companies have different forms of ballasting and dressing. Some raise the ballast as nearly as high as the top of the rail in the center and slope it to the lower edge of the tie at the end; others keep it nearly level with the top of the tie in the centre and nearly as high at the end of the tie, and others still have other forms; but on narrow-gauge track it is essential that plenty of ballast should be at and against the ends of the ties, otherwise it will be very difficult to hold the track in line.

Very many points of work have not been alluded to at all, others but slightly, although they have an important bearing upon the work. We have not mentioned at all what is all important, especially to the contractor, monthly and final estimates, also the manner of making them, building of bridges, crossings, etc., and the thousand and one other matters that enter into the work of construction.

[TO BE CONTINUED.]

HIGH CHIMNEY CONSTRUCTION.*

The first paper, by Hiram F. Mills, C. E., described the "Construction of the Pacific Mills Chimney at Lawrence, Mass," was read by the Secretary. This chimney was built by Mr. Mills in 1873, and consists of an outside octangonal shell 222 feet high, above the ground, with a distinct interior core 8 feet 6 inches in diameter, inside extending one foot above the top of the outer shell and eleven feet below the ground. The chimney is founded 19 feet below the ground upon course sand, the foundation being 35 feet square, enclosed by pine sheet piling. The base is concrete, 1 foot thick, then rubble masonry of large pieces of granite in cement, this stone work being 7 feet high. Upon the stone work is placed the brick chimney, the outer shaft being at the base 20 feet wide, and at the top, under the projecting cornice, 11 feet 6 inches wide. This brick work is 28 inches in thickness at the base; at 12 feet in height it becomes 24 inches, which continues 18 feet; then 20 inches for 20 feet; then 16 inches for 40 feet; then 12 inches for 60 feet; then 8 inches to the top. The inside core is 2 feet thick to a height of 27 feet, and 1 foot thick to a height of 27 feet, and 1 foot thick for the remaining height of 154 feet. The top of the chimney is of cast-iron plates $\frac{3}{4}$ inch thick. The horizontal flue entering the chimney is 7 feet 6 inches square. The vertical flue of the chimney is a cylinder 8 feet 6 inches in inside diameter, and 234 feet high with walls 20 inches thick for 20 feet, 16 inches thick for 17 feet, 12 inches thick for 52 feet, and 8 inches thick for 145 feet. The foundations were laid in mortar of Rosendale cement and sand; the outer shell in mortar of Rosendale cement, lime and sand, and flue walls in mortar of lime and sand.

During the winter of 1873, the flue being 90 feet above the ground, boilers having 452 square feet of grate surface were connected with the chimney with satisfactory results. Between June and September, 1874, the chimney was finished. The approximate weight of the chimney is 2,250 long tons, the number of bricks being about 550,000. The chimney is opposite the middle of a line of 28 boilers and 210 feet distant from them. It was designed to serve for boilers having 700 square feet of grate surface, burning about 13 tons of Anthracite coal per square foot of grate surface per hour.

The chimney was struck by lightning in June, 1880, after which date a lightning rod was put up, which consisted of a seamless copper tube $\frac{5}{16}$ inch thick, one inch inside diameter, at the top of which are seven points radiating from a ball 4 inches in diameter, the top of the central point being 82 feet above the iron cap. The rod is attached to the chimney by brass castings, and is connected at the bottom to a 4 inch iron pipe extending 60 feet to a canal.

A description was then read of the chimney of the Merrimack Manufacturing Co., at Lowell, Mass., built under the direction of J. T. Baker, C. E., in 1882. This chimney is founded on a ledge of sandstone. The foundation, 30 feet in diameter, is built of granite blocks laid as they came from the quarry. At the surface of the ground there is a dressed granite base 2 feet 6 inches in height, laid in clear Portland cement, the remainder of the foundation being in Rosendale cement and sand, upon this base is placed the brick work consisting of three cylinders, the outside one 28 feet in diameter, 24 inches thick, the middle one 18 feet in diameter, 8 inches thick, the core 12 feet inside diameter and 16 inches thick. The middle cylinder is carried up vertically 75 feet 6 inches; the outside ring has a batter of $\frac{43}{100}$ of an inch per foot to a height of 100 feet, at the height of 75½ feet the middle ring connects with the exterior ring, making the masonry at that point 36½ inches thick; it is then 20 inches thick for an additional height of 60 feet; 16 inches thick for 70 feet, and 12 inches thick thence to the enlargement for the chimney head. The core is uniformly 12 feet inside diameter to the top, the first 100 feet being 16 inches thick; then 12 inches thick for 60 feet; then 8 inches thick for 90 feet, and then 4 inches thick for 29½ feet to the top. It is entirely separate from the outside masonry except about the doorways and openings for the flues. The core was laid in mortar of lime and sand; the outside shell in lime, cement and sand. On one side of the chimney is a ladder of iron extending from the ground to the top, and on the opposite is a ¾ inch galvanized iron wire rope, both ladder and rope being connected with a copper ring having four spurs, the central point of which extends 8 feet above the top of the chimney. The bottom of both ladder and rope is connected with a 16 inch water pipe. Two wrought-iron flues enter the chimney, one 5 feet by 6 feet, the other 5 feet by 11 feet. The chimney is constructed to provide for fifteen set of boilers, only twelve now being in use. Each set has 103½ square feet of grate surface, and is rated at 300 horse power. The weight of the chimney is 3,392 tons: 1,101,000 brick were used, and 6,875 cubic feet of stone masonry. The cap weighs 18,600 pounds. The cost of the chimney was $18,500.

A description was then given by Mr. Charles E. Emery, M. Am. Soc. C. E., of the construction of the chimney built under his direction, of the Greenwich Street boiler house of the New York Steam Heating Company. This chimney was a creature of circumstances, it being necessary to place within a very limited area a very large boiler capacity of 16,000 horse power. This was done by making four stories of boilers—the chimney was therefore necessarily located with reference to these boilers, and the plan of the chimney was determined by the shape of the lot. The beach of the Hudson River was at one time at this locality, and the foundation of the chimney was placed in fine clear beach sand with some pockets of coarser sand and a little stone. The foundation is one foot below high water. The chimney is 27 feet 10 inches in the clear inside, and 8 feet 4 inches wide. The height is 220 feet above high water; 221 feet above the foundation; 217 feet above the basement floor; 201 feet above grates of the lower tier of boilers, and 141 feet above the grates of the upper tier of boilers. The thickness of the walls on the interior of the building runs from 5 feet to 20 inches, and on the other side from 3 feet to 20 inches. The gases for each chimney are taken from 32 boilers of 250 horse power each. About 1,000 tons of coal will be burned daily. It is expected that elevator arrangements will be perfected to receive this amount of coal each night. More trouble is experienced with the ashes than with the coal. Ordinary grate bars have been used. Cleaning is done once

*Official abstract of papers read before the American Society of Civil Engineers, March 5, 1884.

every six hours. We have used a new bar that turns on hinges and gives good results. We have not made many experiments with coal dust. We have to use a fuel which has some reserve power to provide for possible contingencies. We find coal is worth about what is charged for it.

Mr. P. C. Griswold, M. Am. Soc. C. E., described a chimney erected in Mexico, for a cotton factory about 150 feet high which had been in use for over 12 years which was built of apparently sun-dried bricks, and which seemed to be now in excellent condition. This chimney was built by Indians and seemed to be very symetrical and well made. The bricks were about 10x3x7.

Mr. H. W. Brinckerhoff, M. Am. Soc. C. E., described a chimney constructed of old rails, which was in successful use in Pennnsylvania. It was generally known as a crinoline chimney.

Mr. Wm. E. Worthen, M. Am. Soc. C. E., referred to several chimneys built by him, and expressed a doubt as to the necessity of very great height in chimneys.

Mr. J. M. Knap, M. Am. Soc. C. E., described chimneys constructed in Pittsburg, and which though of very moderate height had given excellent results.

The subject was further discussed by Messrs. Cooper, Croes, J. P. Davis, Hamilton, Fteley and Prindle.

REGISTERING SPEED ON BRIDGES.

On the Dutch Southeastern Railroad bridge over the River Maas, at Ravesteign, an automatic instrument is used to register the speed of passing trains. For the maintenance and safety of bridges of long span, it is thought desirable to limit the speed of trains to 18¾ miles an hour, particularly with the increasing weights now carried.

The arrangement consists of two parts:

1. At each end of the bridge is a fixed pedal, placed against the rail so as to be depressed by each wheel of the train passing that spot.

2. Each depression of the pedal makes contact in an electro-magnetic circuit which acts on needles placed against a cylinder situated at any convenient distance. The cylinder is made to revolve by clock-work at a uniform speed, and is covered with a sheet of paper.

While no wheels are passing the pedals on the bridge, the needles mark straight, parallel lines on the revolving sheet of paper. But if contact is made, as above mentioned, the respective needles are momentarially deflected and mark the instant at which each wheel passes the pedal in connection with the bridge.

The distance apart of the pedals at each end of the bridge being known, also the rate at which the registering cylinder revolves, the speed of the passing train can be deduced by simple measurement of the distance apart of the traces made by the marking needles.

As a further check the number of axles of which the train is composed, is marked at the same time and in the same way by the needles deflecting at each contact in the circuit.

PETROLEUM AND BIBLICAL SALT.—Many things become comprehensible if we take the generic term salt and apply it to petroleum and its residue, asphalt. Lot's wife, if converted into a pillar of common salt, would have been washed away by the first shower of rain; but a pillar of asphalt, even as a memorial of her, would have been an enduring monument, and might have been seen by Josephus and his contemporary, Clement of Rome, both of whom declare they saw it. So, also, when we are told by Mark that "every one shall be salted with fire, and every sacrifice shall be salted with salt," I see a meaning only when I recollect that, in regions containing petroleums sacrificial fires were fed with this fuel to aid the burning. In like manner, when Matthew likens the blessed first to salt and immediately afterwards to a lighted torch (for candles, as translated, were then unknown) I see the connection in his mind. He had just said that salt which had lost its savor was only fit to be trodden under foot of men. Now salt never does lose its savor, and is never fit to be trodden under foot. But petroleum does lose its essence by exposure, and, out of the residue the ancients used to make asphalt pavements, as they do at the present day. I only give some reasons for my belief that the salt of the Bible, in its generic sense, was often applied to petroleum; but I admit at the same time that the readers of *Good Words* ought not to attach much importance to my opinions on any subjec of Biblical criticism.—*Sir Lyon Playfair, in Good Words for February.*

THE IRON TRADE.

Prices of all kinds of Iron and Steel, outside of specialties in those productions, have been depressed to the lowest limit at which production can be maintained, and hence, during the last thirty days, a number of requirements have been presented and contracts made for material to be furnished during the spring and summer months, and additional contracts have been entered into, in many cases, for supplying material for even later requirements. The Bessemer mills have secured orders for several hundred thousand tons of rails, and none of them will be obliged to seek business until near midsummer. The probabilities point strongly to the piling up of orders for rails, to meet the considerable building requirements already announced and to be undertaken at a very early day. Fewer than usual locomotives have been ordered this year. Larger car orders than usual have been given out, and at the present time orders for between seven and eight thousand cars, most of them for the transportation of coal, coke, lumber, oil and ore, are pending, and will be placed probably in a very few days. During the past month the orders for Structural Iron which have been heard of, will foot up to some twelve to fourteen thousand tons. Much of this was made up of small orders. At present writing, brokers representing Structural Iron manufacturers, as well as the manufacturers themselves, have inquiries in hand for the purchase of Structural Iron amounting to between nine and ten thousand tons in all. The brokers speak of several other large requirements that will probably be presented during the months of April and May. The managers of several of the trunk and smaller lines have recently announced that the work of improving the road-beds and increasing the facilities for the movement and handling of freight will be continued, a statement borne out by those who are handling railway material of all kinds. The railways are the heaviest and best customers of the iron interests. A good many journals speak rather dolefully of the present condition and prospects of trade. Many of these statements, no doubt, are well grounded, but in many instances they represent isolated cases rather than general conditions. American manufacturing interests have for several years been accustomed to a kind of booming prosperity, and do not very willingly accept the probabilities of close trade and narrow margins. The fact may as well be plainly stated and comprehended that the future producing capacity of the country will not be fully employed for a year or two to come, but this does not involve any actual depression. The normal and legitimate requirements of the country are sufficient to occupy the people, its capital, and its machinery of production and exchange. Meanwhile some of the new problems will be investigated and, if possible, solved; such as, for instance, the development of an export trade with the countries on this hemisphere; secondly, the development of more profitable commercial connections with Canada and Mexico; thirdly, the development of the capabilities and resources of the country in the older State; fourthly, the development of an internal canal system. There is room for much labor in each of these vast fields. Referring to the third, we find that emigration is seeking the four corners of the country for homes an opportunities, fleeing from what should be a place of good homes. The older States, when properly supplied with railroads and when their resources of coal, ore and lumber are properly utilized, will be found able to support a much larger population. Their railroads can be quadrupled.

The elements exist for the multiplication of roads and manufactories and for an unlimited increase in wealth and a great expansion in industrial activity. Too little attention is given in many of these States to their advantages and to the elements of wealth which they contain. Too much attention is given to the far off West where in reality the opportunities for the employment of capital and labor are not as abundant and attractive as nearer home. Several railroad companies have within the few months begun to recognize the importance of the question here presented and have quietly purchased lands for the purpose of profiting either by their development or by the advance in values which will grow out of the gradual increase in population. One company has prepared to invest $12,000,000 in such enterprises: another, $2,500,000; another, $500,000; another, $1,000,000. These are but a sample of the movements which are now in progress for the investment in lands for traffic and speculative development. The same land-grabbing enterprise is displayed in the Southwest. One purchaser recently bought 300,000 acres of land in Texas. Several British companies have purchased enormous tracts there. An English syndicate has recently bought a large tract of land in the Mississippi bottoms. Land is rapidly rising in value prospectively. Its development to the highest degree possible is only a question of time, and engineering ability will be brought into requisition to accomplish this result. Railway building will be the pioneer instrumentality. The decentralization of industries will be the second step in this industrial progress. The latent energies of the people are only awaiting the guiding hand of engineering skill, and the clear vision of intelligent capital to direct, it will be the third prime factor or instrumentality for the utilization of the endless variety and extent of resources in all these States, the surface of which has as yet only been scratched.

SELECTED MISCELLANY.

THE largest city in Japan is Osaka, which contains 1,585,696 inhabitants.

TORONTO, Ont., celebrated the fifteenth anniversary of its incorporation as a city on the 6th. In 1834 the city assessment was $934,000, and in 1884 $65,222,950. In 1834 the population was 9,200, and in 1884 95,000.

ILLINOIS labor statistics state that the average value of 10,508,791 tons of coal mined in that State last year was $1.46, the price having varied scarcely any for three years. The miners received from 45 cents per ton at the lowest, in Washington and Perry counties to $1.50 in low and wet workings in northern parts of the State. The ruling price throughout the central part of the State is 75 cents, and in the Northern from 85 cents to $1 per ton.

ASA A. TUFTS, of Dover, 86 years old, has kept an accurate account of the weather in that place making three observations and an average daily record since 1830. This data is preserved and bound in successive volumes. Mr. Tufts has also kept a record of the leading events in Dover, as well as many in the country at large. He was engaged in the drug business in Dove from 1813 to 1847, and his son, Hon. Charles A. Tufts, now carries on the establishment, making thus far 71 years of continuous trade by father and son. The latter is well known as a book collector. He has, including reprints of 1787 and 1789, a complete set of the New Hampshire Register. Of the first year, 1772, only three copies are known to be in existence, and those are owned by Hon. John Wentworth of Chicago, Jos. A. Stickney of Great Falls, and Mr. Tufts. The last named was recently offered $50 for his copy, but refused it. It is a pamphlet of 16-pages and was printed at Portsmouth.

A New York scientist claims to have discovcovered, along the Lehigh Valley, a hitherto unknown metal, which will some day supplant nickel in general use. He was making an experiment with an explosive substance mixed with pulverized furnace slag, which, on being heated, caused an explosion to take place Upon examining the crucible in which the mixture of material had been, he found that a chemical process had taken place by which an apparently valuable, but hitherto unknown, metal had been eliminated from the slag. It was silvery white in color, of fine, smooth texture and susceptible of a brilliant polish that no exposure will tarnish. It was also found to be malleable, ductile and of great tenacity, showing a tensile resistance of 140,000 pounds to the square inch. Further experiments only confirmed the results of the first trial, and a company has now been organized for the purpose of "working" the large slag banks along the Lehigh Valley for the new metal.

AFTER seven years of idleness the larger furnace of the South Boston Iron-works was lighted up on March 1, for the casting of a 12-inch rifle mortar for the United States Ordnance Department. This is to be the first of a lot of five heavy experimental guns authorized by the last Congress. The second will be a 10-inch breech-loading rifle. The body is to be of cast-iron, reinforced by a wrapping of steel wire. The third is to be a 12-inch breech-loading rifle, entirely of cast-iron, and is to weigh 57 tons. The fourth is to be like the third, with the exception that it is to be lined from the breach with a short steel tube, to reach a little beyond the trunnions. The fifth is to be a 12-inch breech-loading rifle. The body, of cast-iron, is to be reinforced by steel rings around the breech and to be lined the full length with a steel tube. It is expected that these heavy rifles wil endure charges of 200 to 300 pounds of powder, with projectiles weighing 700 pounds, giving a velocity sufficient to penetrate 24 inches of iron. The works also have contracts with the United States Navy Department for 6 and 8 inch steel breech-loading rifles for the new steel cruisers, and for the conversion of 10-inch smoothbore "Rodman" guns into 8-inch muzzle-loading rifles, for the War Department.

FROM an interesting work by Dr. Otto Krummel, of Gottingen, we learn the extent of the different seas on our globe. According to his calculations, the Atlantic Ocean has a superficies of 49,429,468 square miles; Indian Ocean, 45,462,040 square miles; Pacific Ocean 99,897,917 square miles. Thus the total superficies of the three large oceans is 194,787,425 square miles. The Arctic Ocean has a superficies of 9,481,294 square miles. In the Arctic Ocean Hudson Bay has a superficies of 663,249 square miles, and the White Sea 7715 square miles; the Australian Sea, 5,112,491 square miles; Mediterranean, 1,789,029 square miles; Baltic, 257,869 square miles; Red Sea, 273,944 square miles; Persian Gulf, 146,837 square miles. Then come the seas that Drf Krummel calls coast seas, namely: North Sea, 339,526 square miles; Sea of Great Britain, 126,290 square miles; Sea of St. Laurent, 170,109 square miles; China Sea, 761,632 square miles; Japan Sea, 647,170 square miles; Sea of Okhotsk, 934,717 square miles; Behring Sea, 1,440,338 square miles; Sea of California, 163,678 square miles The total superficies of the coastal seas is 4,523,460 square miles. Adding the Antarctic Ocean, the superficies o which is calculated at 12,696,256 square miles, the tota superficies of all the seas is 230,915,905 square miles, while the total superficies of the continents and islands of the globe is only 34,334,950 square miles.

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AND

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CITY ENGINEER KNIGHT, of Kansas City, seems to be an important factor in the political struggle now going on in that city. The Republican battle cry is "anti-Knight," though this gentleman himself seems to hold his position by Republican appointments. We are too far removed to be posted upon all the issues at stake, but from external evidence should say that Mr. Knight has proven himself an active and efficient officer; the ways of political factions are past finding out, however, and if Mr. Knight does not suit the dominant party, for reasons good or bad, Mr. Knight must go. He is being well advertised in the meantime, and the present struggle over his reappointment is rather complimentary than otherwise, for it is generally the fearless, active and honest engineer who antagonizes the average city politician.

PANAMA CANAL NOTES.

From the *Bulletin* of Feb. 15, 1884, we make the following notes:

	cu. yds.
The total work done in January	773,000
Excess over December work	260,000
Total work done to January 30, 1884	4,009,378

In reference to the burning of the American dredge "Prosper Huerne," the cause of the disaster is still unknown. The loss to the owners, Mr. H. B. Slaven & Co., is considerable; it is estimated at $150,000. Mr. Slaven at once telegraphed for Dredge No. 3 to be sent immediately to Colon, and has ordered a fourth dredge, to be finished as quickly as possible.

The estimated value of the general plant now on the Isthmus is given at 75,600,000 francs ($15,120,000).

The observed rainfall at the following points in 1882, was:

Colon	124.07 inches,	in	230 days
Gamboa	75.79 "	"	157 "
Naos	29.40 "	"	124 "

Springfield, Mass., Municipal Reports.

We have received the reports of the Board of Water Commissioners and the Superintendent of Streets and Sewers, for 1883.

Little more than routine work has been done in the water department during the year; 70.23 miles of main and distribution pipes are now in use, and the total cost of the works to December 10, 1883, is $1,276,915.19. The cost of maintenance for 1883 was $14,860.81, including all expenses; the entire receipts from all sources, except construction were $88,642.54; the expenditures for the same, $21,864.92—leaving a balance of $66,777.62 for payment of interest on bonds.

The Superintendent of Streets and Sewers reports, incidentally, the destructive effect of the Steam Heating Company's Expansion boxes upon the macadamized streets of the city; he says the steam heat dries out the moisture of the cementing or binding material, leaving the dry stone to be picked out by the hoofs of passing horses. The repairs and improvement on streets cost $53,595.23 in the year, $25,964.55 was expended upon sewer construction, and $3.098.53 in cleaning and repairing sewers.

The entire 35.32 miles of existing sewers cost $445,596.53, of this length 8.77 miles are brick and cement sewers—the largest, 7 ft. dain.—and the remainder pipe sewers, cement pipe footing up to 23.87 miles.

The Water Supply and Sewerage of Norfolk, Va.

The annual message of Mayor Wm. Lamb, of Norfolk, Va., contains the municipal reports of that city to June 30, 1883. From them we extract the following items relating to the water supply and sewerage.

With a population of 26,188, there are 2758 water takers and a daily consumption of 920,136 gallons. According to the report of the Water Commissioners, the sum of $3,695.86 has been expended in excess of the water tax received, and the net revenue for the years 1880, '81 and '82; this deficiency is due to so-called "extraordinary expenses" of $27,345.96, the exact meaning of which is not expressed. The present 12-in. pumping main having reached its maximum of supply capacity under domestic pressure, a new 20-in. main is recommended from the reservoir to the city, and also a new conduit from Lake Lawson to the reservoir, to replace the old wooden box conduit laid in 1872 and now rotted beyond repair; the estimated cost of these lines is $189,257.20.

In speaking of the new Waring sewerage system, the city engineer says that the total amount of pipe laid to date was as follows:

25,141 L. feet or 4.76 miles on section C.
21,450 " or 4.06 " on " B.
46,591 " or 8.82 " total laid.

Section C is in full operation, and is so far successful and satisfactory; but section B requires 11,808 L. ft. of the heaviest part of the work to be done before the pipe laid can be utilized. The expenditures for the above work was $139,403.19, as we infer from the report, and $139,067.11 is required for the 10.35 miles of sewer yet to be laid, to complete the system. In this connection the City Engineer reminds the authorities that the royalty of 10 cents per lineal foot, or $4,659.10, is still due on the pipes already laid, to Col. Waring and the company.

The Board of Health, of Norfolk, report that in a population of 13,777 white and 12,411 colored, the total deaths, in the year ending June 30, 1883, were 275 whites and 418 colored. The death rate per 1,000 is thus shown to be 18.98 for whites and 33.67 for the colored inhabitants. This is a heavy mortality rate, and proves in the case of the poorer class, the extent of the dangers to which they are exposed from the want of proper sanitary improvements, neglect of sanitary regulations, and the general ills due poverty and unhealthy homes.

New York Board of Public Works.—Report for 1883.

H. O. Thompson, Commissioner of Public Works, New York City, has submitted his report for the year ending December 31, 1883.

The total expenditure for the year was $4,714,276.13; 234 contracts were made at an estimated cost of $2,677,114; 195 contracts were completed in 1883 at a cost of $2,238,617.

In speaking of the long-looked-for new water supply the report says:

The average rainfall in the Croton water-shed for the year was 42.84 inches, which is 4¾ inches less than the average for the past ten years. The drafts upon storage reservoirs and lakes, to keep up a full supply to the aqueduct was quite large, amounting in the aggregate to 4,370,000,000 gallons. The year's experience strengthens the conviction that the largest possible supply from the Croton water-shed can only be obtained by the construction of the large reservoir at Quaker Bridge, near the mouth of the river, recommended in previous reports. A large part of the engineer force under the chief engineer of the Croton Aqueduct, has been engaged in surveys for the Aqueduct Commissioners. The result of the surveys and examinations has been transmitted to the Commissioners from time to time in various reports, maps and documents, including maps showing the Quaker Bridge Reservoir and the aqueduct line thence to the city; the aqueduct line from Pocantico River to Croton Lake; sketches of cross sections of the proposed new aqueduct: elevation, plan and section of Quaker Bridge Dam: section of foundation and specifications for building the dam. The leaks through cracks or fissures in the present aqueduct, caused by settlement of embankments, have recently become more troublesome than usual. A large leak which suddenly developed north of King's Bridge on November 15 made it necessary to close the aqueduct and interrupt the delivery of water into the city reservoirs for 42 hours. The leak and 2,003 lineal feet of bottom cracks were repaired. The following work was done in reinforcing the weak portions of the aqueduct: 2,349 cubic yards brick and stone masonry; 2,120 cubic yards dry stone wall and culverts; 826 lineal feet of waste pipe laid: 15,601 cubic yards earth excavated; 1,417 cubic yards rock quarried; 14,855 cubic yards earth placed in embankments; 13,166 lineal feet of fence built.

Work on the Bronx River system is reported as advancing rapidly; of the 13 contracts for the various portions of the work, 8 are finished and the remainder should be finished in 1884. By September 1, the department expects to furnish 5,000,000 gallons daily through the conduit, to be distributed in the 23rd and 24th wards; toward Autumn this supply will be gradually increased to about 10,000,000 gallons per day. As this work is sufficiently advanced to allow a close estimate of the cost of unfinished work, the total expenditure at this point is given as follows:

Actual cost of land, water rights, etc.	$ 482,282
Actual and estimated cost of construction	$2,040,646

The above does not include the Williams Bridge Reservoir, the water rights on the Lower Bronx River, and the work for the Byram River supply.'

On December 31, 1883, there were 547 miles of pipe and 5,743 stop-cocks, and 7,153 fire hydrants in the water distribution system of New York City. Commissioner Thompson says the new Worthington pumping engine at High Bridge has developed a duty of 75,000,000 foot pounds with 100 pounds of coal, exceeding the requirements of the contract, and that the expense, for fuel, oil, etc., is about one-half as that required for the old engines.

The Water Inspectors made during the year 15,308 house inspections, 9,893 night inspections of house drains, and reported 1,770 cases of leaks from defective plumbing, and 1,614 places were water was wasted; 9,012 meters are in use, measuring 16,283,800 gallons of water per day.

There are now under the streets of New York 547 miles of water pipes, 398 miles of sewers, 857 miles of gas-pipes, 16 miles of steam-pipes, 17 miles of electric wires, 3 miles of tubes for telegraph wire, and ¾ miles of pneumatic tubes; a total of about 1,840 miles.

The total revenues from water rents, penalties, permits, etc., was for 1883, $1,869,518.96; the revenue from other sources, due this department, swell the total receipts to $2,029,335.74.

Standard Bridge Specifications.

The vagaries and often absurdities of the average specifications submitted to contractors for the erection of iron bridges and viaducts, has long been a subject of severe comment; and they have as often been the cause of unending confusion and controversy between the contracting parties.

The chief engineer of the road is too prone to issue his own specifications for work; something original—and very original they often are. If he has had long and mature experience, and has devoted years of patient, intelligent labor and study to the subject under investigation, he probably improves upon past methods and his opinion is of value. But, as is too often the case, when the engineer has not had sufficient practical experience to design for himself, but makes up a hodge-podge of the acknowledged good points of a number of standard specifications; the result is generally confusing, and often absurd. The principal that if each point is good, the compounding of these points is better, may do for the maker of a patent medicine, but will not apply in bridge building.

Mr. Theodore Cooper, an acknowledged expert, and an engineer of long and varied experience in this especial branch of his profession, has come to the aid of the inexperienced engineer above described, the man who has so long complained that he was forced to make up his own rules by piecemeal because a standard was lacking.

Mr. Cooper gives the result of his study and experience in the shape of a published set of "General Specifications for Iron Railroad Bridges and Viaducts," divided into classes A. B. and C. according to the "rolling load" used. Class A provides for two "consolidation" engines coupled, followed by a train weighing 3000 lbs. per running foot. Class B is for two "consolidation" engines coupled, with a train of 2240 lbs. per running foot. And class C is for two "mogul" engines coupled, followed by a train weighing 2000 lbs. per running foot. All of these loads are for each track and for trains supposed to be moving in either direction; diagrams show the concentration of the load in each case.

Under each class heading the requirements for the many details of construction are much more fully and clearly expressed than we ever remember seeing them. There is no mistaking the meaning of these specifications, no room for dispute; an advantage, to both engineer and contractor, that cannot be too highly prized.

We speak of these general specifications in the interest of all concerned; for their own merit and for the good that may be derived from them. The fitness and the experience of their author is undisputed; he only differs from other competent experts in making public this experience and knowledge for the benefit of those members of his profession who have not had the opportunity for investigating the subject for themselves.

The builders of iron bridges also owe a debt of gratitude to Mr. Cooper for his attempt to relieve them of the obscure meaning and conflicting requirements of so many of the specifications under which they are called upon to construct.

PERSONAL.

FRANCIS C. TUCKER, late resident engineer at Mullan Tunnel on the Northern Pacific Railway, has opened an office as civil engineer and surveyor at room 20 Yesler-Leary building, Seattle, Washington Territory.

AN excellent opening is afforded for a live business manager possessed of some capital. The Durham House Drainage Company has already built up a fine trade and its future is most promising. We call attention to its advertisement elsewhere.

GEORGE TRUSCOTT, formerly a member of the Board of Water Commissioners of Buffalo, N. Y., died on March 4, aged 60 years.

GEORGE B. LAKE has been appointed principal engineer of the Atchison, Topeka and Santa Fé Road, and will assume the duties heretofore performed by General Manager Robinson, though the latter will still retain his old title of Chief Engineer.

CHARLES A. DANA, S. L. M. Barlow and a number of friends will be among the first to visit the City of Mexico via the Mexican Central Railroad, which is now completed. Mr. A. J. Cassatt, of the Pennsylvania Railroad, who has gone to Mexico by way of Vera Cruz, expects to return by railroad.

THE New York Aqueduct Commissioners, including the Mayor, Controller Grant, and Commissioner Thompson, of the Department of Public Works, left the city March 11, by the Pennsylvania Railroad for Baltimore and Washington, for the purpose of inspecting the water systems of those cities. The Commissioners were accompanied by Chief Engineer Church, Consulting Engineer Adams, and Engineer Newton, of the Department of Public Works.

JAMES L. SHIPMAN died at Huntington, on March 7, aged 75 years. He was born in Saybrook, Conn. In 1836 he was made a resident engineer of the Long Island Railroad, and soon after chief engineer of the road, which at that time was being extended eastward from Jamaica. Upon the completion of the line he undertook the management of the construction of the Harlem Road, and carried it successfully through to its completion. He also constructed several important Western railways. He was at one time a member of the firm of Shipman & Martin, which built a number of branches for the Long Island Railroad Company during the Presidency of Mr. Morris and the late Oliver Charlick.

CHARLES KELLOGG and Charles S. Maurice, of Athens, Pa.; George S. Field and Edmund Hayes, formerly of the Central Bridge Co., of Buffalo, N. Y.; Charles Macdonald, late of Delaware Bridge Co., New York City, and Thomas C. Clarke, late of Clarke, Reeves & Co., of Phœnixville, Pa., entered on March 1, 1884, into a general partnership under the name of the Union Bridge Company, with office in New York City. Their works will be at Athens, Pa. and at Buffalo, N. Y. This partnership consolidates into one company, the Kellogg and Maurice Works of Athens, the Central Co. of Buffalo, and the Delaware Bridge Co. of New York, and deprives the Phœnixville Company of the name which has so long headed that firm.

ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF REGULAR MEETING, MARCH 1ST, 1884.

President Wm. Ludlow in the chair; 34 members and 8 visitors.

President Ludlow described tests of the Crushing Strength of Ice, which were made by him in order to learn, approximately, the strength required for an ice harbor of iron screw-piles, in mid-channel, at the head of Delaware Bay. Eighteen pieces were tried with government testing machines at Frankford, Philadelphia, and at Fort Tompkins, Staten Island. The specimens were carefully prepared 6 inch and 12 inch cubes, and roughly cut slabs about 3 inches thick, of different qualities and from different localities. For pure Kennebec ice the lowest strength obtained was 327 pounds, and the highest 1,000 pounds, per square inch. For inferior qualities the strengths varied from 235 to 917 pounds. The higher results were obtained, generally, when the air temperature in the testing room was from 29° to 36° F.; as against 55° to 68° F. for the lower results. The pieces generally compressed ½ to 1 inch before crushing.

The Secretary exhibited for Mr. C. A. Ashburner a set of blues of some yet unpublished details of the Chicago Cable Railways.

The Secretary presented a note, by Prof. W. S. Chaplin, upon a prevalent error in data given for Determining the True Meridi observing the instant at which Polaris and Alioth come into the same vertical, and then following Polaris for a *certain time*, at the expiration of which it is said to be on the meridian. He gives, as the true time, the following: Lat. 40°, 25 min., 36 sec.; Lat. 50°, 25 min., 24 sec.; Lat. 60°, 25 min., 5 sec.; Lat. 70°, 24 min., 29 sec.

Mr. C. J. Quetil, visitor, exhibited models of the Wire Truss recently described by him.

Prof. Mansfield Merriman presented a statement of the progress of the Triangulation carried on in Pennsylvania by the United States Coast and Geodetic Survey, and exhibited a map showing its present condition. The stations located are twenty-seven in number, of which nineteen have been occupied for the measurement of angles. These are in the southeastern part of the State, in the counties of Bucks, Monroe, Carbon and Schuylkill. The geographical positions of the stations have been computed from two of the sides of the primary coast triangulation, one near Elkton, Md., and the other near Trenton, N. J., which serve as bases for the work thus far executed.

The Secretary announced the receipt of the following contributions to the library from two very good friends of the Club: from Gen. Wm. F. Raynolds, several hundred valuable Reports, Documents and Maps, and from Mr. Thos. L. Lüders a handsome framed photograph of the New Public Buildings at Brussels.

THE IDUSTRIAL SITUATION.

The past 30 days have not developed the activity predicted for them by those who generally give correct opinions in regard to the course of events. The manufacturing interests have been slow to accumulate stocks, or to take any steps which would unsettle the present healthful tendencies, or further depress prices. Only a moderate amount of material is being made. Shops, mills, and manufactories of all kinds, are working only on orders; excepting in the textile interests, which are obliged to carry large assortments of goods. But even in this department, the supply is so carefully regulated to demand, that mills are practically running on orders. The steel rail mills have orders running from three to seven months ahead. Buyers of rails are still hanging back, waiting for developments, and more active competition among makers. A very wise conservatism still prevails and only such railway building will be undertaken, as is fully justified by the traffic requirements of the country. Fewer long lines are projected at this time, than for several years. The ordering of locomotives seems to have received a check, although there is a large amount of business on hand, especially at the older and larger establishments. This fact is shown by the continuance of the same labor force. The only discouraging feature about locomotive building, is the fact that orders do not run far ahead as heretofore, and, unless new orders are placed, there will be extensive disemployment of labor, especially in the smaller establishments who cannot stand the increasing competition which is resulting from the declining railway requirements.

The nail trade is creeping along on its hands and knees, so to speak, afraid to throw its full production on the market. The New England strike still continues. The western floods have seriously interfered with the spring demand. Prices, $2.50. Only a jotting demand is reported from leading centres. The spike mills are doing better, a large amount of material is being purchased for shipping south, during the next sixty days. Makers of textile ma-

chinery are actively employed, and a liberal amount of machinery, tools, material and equipments of all kinds, will begin in the course of two or three weeks. A great deal of capital is being attracted southward, and this demand will continue active through the year, and thus compensate for the falling off in some other directions.

Engineering enterprises are still being announced, and though their number is restricted, as compared to last year, some of them are of heavy proportions. Some ten to fifteen thousand tons of structural iron will be wanted for bridges in Pennsylvania, and it is probable that much more than this will be wanted for railway bridge construction in the South. Western bridge works are well supplied with orders and Eastern works have no cause for complaint.

The financial situation is all that could be desired at present. While some makers see handwriting on the wall, it is not very legible to men of plain practical business sense. The banks are well supplied with money. The exportation of gold will be forgotten in sixty days. The trifling stringency is due more to exceptional, than to general causes. The people are for the most part, busy and making money. Congress is dealing very gently with the business interests and can be trusted to do no harm.

CAMBRIDGE (MASS.) REPORTS FOR 1883.

We are indebted to Wm. S. Barbour, City Engineer of Cambridge, Mass., for the last report of the City Engineer and Water Board.

With an estimated population of 60,000, the daily average consumption for 1883 was 44.77 gallons per head, including all water used for mechanical purposes, watering streets, fires, etc. An additional water supply is required; the Commissioners prefer water from the Shawsheen River, but mill owners object; the future supply will probably come from Stony Brook.

The works have cost to date, $1,751,344.97, the revenue from water rates for 1883 was $179,361.89.

The City Engineer, among other matters, reports that the work of developing the property of the Charles River Embankment Co., has been commenced; 1,000 Lin. ft. of sea-wall on the harbor, is under contract, and 300,000 cu. yds. of dredging is also under contract and partly done. 2.392 miles of sewers were built in 1883, making 67.276 miles in total in the city.

BUSINESS NOTICE.

A New Process for Copying Drawings and Tracings.

To the engineer and the architect the rapid duplication of drawings and tracings is an important business requirement. But a few years ago, transparent paper or tracing linen was the only medium of transfer. The Blue Process which was the next introduced, was hailed as a wonderful advance upon old methods, and resulted in a material saving in labor and cost; but it was open to objections, the copy was in white lines upon a dark blue background, it was difficult to make any corrections or additions to the original drawing, and a copy on tracing linen was first required as a negative to work from.

A new process has now appeared, which from specimens sent us, seems to be as much superior to the Blue Process as that was to older methods. It is called the Keuffel & Esser "Lightning Black Process," and the copy can be made directly from drawings on Whatman or other similar drawing paper; from 2-ply Bristol board or from tracing cloth. The lines appear in solid *black* upon a *white* ground, and the finished copy is permanent and presents a water-proof surface. The above firm are prepared to duplicate drawings by this new process, and interested parties should apply to them.

NEW PUBLICATIONS.

Steel and Iron—Comprising the Practice and Theory of the several methods pursued in their manufacture, and of their Treatment in the Rolling Mills, the Forge, and the Foundry. By William Henry Greenwood, F. C. S., Assoc. M. I. C. E., M. I. M. E., Associate of the Royal School of Mines. With 97 diagrams from original working drawings. Cassel & Co., publishers, London, Paris and New York, 1884. Price $2.00

The author of the above work has aimed at the production, within moderate limits, of a comprehensive manual of practical information, and of the scientific principles upon which the practice rests. He intends this book to be not only of service to the student of this especial branch of the technical sciences, but to give the intelligent workman a plain and condensed statement of the scientific principles upon which depend the success of the processes conducted by him.

The subject matter has been as far as possible brought up to date, and the illustrations, though small in size, are reduced from actual working drawings.

The space levoted to a book notice will not permit us to enter as fully into the contents of this work of over 500 pages as we would wish; it will suffice to say, however, that the author, handles his subject as one experienced, and in a way that is both interesting and instructive. Commencing with the refractory materials, and the ores and metallurgical chemistry of iron, he passes on to its production; the furnaces, foundry appliances, and the direct and indirect methods of making malleable iron. He describes and illustrates the refining process, the puddling and the plant required for forges, mills and furnaces.

Under the head of steel, he begins with the Catalan furnace, describes the Chenox and the Cementation process, treats of the melting and casting of crucible steel, and matters pertaining to this branch of the arts. The Siemens, Siemens-Martin, Bessemer, Heaton, and in fact, all the accepted modern methods of converting iron into steel, are included in Mr. Greenwood's treatise. In view of the rapidly growing demand for steel in engineering construction of nearly all kinds, this book should be popular; it is in any event a valuable addition to the "Manuals of Technology," issued by its publishers.

Topographical Surveying including Topographical Surveying by Geo. J. Specht, C. E. New Methods in Topographical Surveying, by Prof. A. S. Hardy. Geometry of Position Applied to Surveying, by John B. McMaster, C. E. Co-ordinate Surveying, by Henry F. Walling, C. E." Van Nostrand's Science Series No. 72. Price 50 cents.

The above treatises are re-printed from Van Nostrand's Engineering Magazine, and contains much of interest and value to the engineer. The first named in the title is a practical description of the Stadia system of measurement, with illustrations; a subject upon which we have had a number of inquiries.

Dynamic Electricity, its Modern Use and Measurement, chiefly in its Application to Electric Lightning and Telegraphy; including. I. Some Points in Electric Lightning, by Dr. John Hopkinson, F. R. S. II. On the Measurement of Electricity for Commercial Purposes, by James N. Schoolbred, M. Inst C. E. III. Electric Light Arithmetic, by R. E. Day, M. A." Van Nostrand's Science Series No. 71. Price 50 cents.

This little book is devoted entirely to the practical use of electricity; the article by Dr. Hopkinson was a lecture delivered before the Institution of Civil Engineers, and that of Mr. Schoolbred was prepared for the Society of Telegraph Engineers, and is somewhat technical. The arithmetical part, No. III. is filled with problems and their solutions daily met with in the practice of electric engineering.

How to Make Photographs, a Manual for Amateurs. By J. C. Roche. E. & H. T. Anthony & Co., New York, Publishers. Price, 50 cents.

While not usually classed among the arts essential to engineering knowledge, photography as now simplified and cheapened in outfit and manipulation, might be made very useful to the engineer. Faithful views of any important work, taken while that work is in progress, and at short intervals, make the best record of the methods employed that can be obtained. With the $10 or $12 outfit, herein described, any engineer can keep his own record of work, accident or incident; to be valuable as a reference, or pleasant as a reminiscence.

The Air We Breathe and Ventilation. By Henry A. Mott, Jr., Ph. D., E. M. F. C. S., etc., Prof. of Chemistry in the N. Y. Med. College and Hospital for Women; Member of the American, Berlin and Paris Chemical Society, etc., etc. Author of "The Chemist Manual;" "Was Man Created?" etc. Mott Series No. 2. John Wiley & Sons, Publishers, N. Y. Price, $1.00.

This little book is intended for the public generally and the tenant, physician and architect in particular. The Aspirating system of ventilation has been presented to the exclusion of all other systems proposed, as being, in the opinion of the author, the most correct in principal.

In handling his subject, Prof. Mott first describes the elements entering into "the air we breathe:" he gives the composition of the atmosphere, and, under distinct heads, the quantity, gravity and action of the water, nitrogen and oxygen which form it. Carbonic acid, carbonic oxide, ammonia and the sulphur compounds; their origin, and the effect their presence has upon the human organism, are all carefully explained.

As remarked above, the author believes in withdrawing foul air from a room or building, instead of attempting to replace it by fresh air forced into the same space. After stating the requirements for good ventilation, Prof. Mott describes the different systems embodying the principles advocated by him. The Cameron or cornice system of ventilation is first taken up and its modes explained by copious text and diagrams. The Gouge system, an artificial induction of air up a vertical shaft, is next illustrated, in similar manner. The Spalding system, circulating fans of a variety of types, the ventilation of theatres, school rooms, etc., are all clearly treated upon under the separate heads.

The text is well illustrated with cuts and diagram explanatory of the systems and theories recommended.

LIVERPOOL ENGINEERING SOCIETY.

The second meeting of the session was held on Wednesday evening, January 30th, at the Royal Institution. The Vice-President Mr. J. S. Brodie, M. I. M. E., in the chair, when Mr. T. S. Miller described some improvements in air compressors, stating that in using india rubber for the inlet valves it is found that the heat generated in compressing the air raises the temperature of the valve guards to such an extent that the india rubber is liable to burn and stick. To prevent this Mr. Alfred Chapman, the patentee, makes the guards hollow and circulates water through them, which afterwards issues through perforations in the tops of the guards into the cylinders in the form of a spray. The water has a three-fold effect, viz.: First, it keeps the temperature of the guards down to such a point that no injury results to the valves. Second, in the form of the spray it lowers the temperature of the air which is being compressed in the cylinder. Third, it takes up the clearance space in the cylinder so that every particle of air is discharged therefrom. The discharge valves are of the ordinary flap form being a thin sheet of phosphate bronze about 20 B. W. G.

Mr. Wilfred S. Boult, Assoc. Mem. Inst. C. E., exhibited and described "Boy's Engine Power Meter. He commenced by explaining that this meter is designed for directly measuring without recourse to the delicate, tiresome, and often uncertain process of taking a diagram of the work being done by steam, gas, water and hot air engines. The instrument is truly a *power meter* and not a mere *indicator*. Instead of one giving a diagram of steam pressure in one end of the engine cylinder during a single stroke, and leaving the diagram to be subsequently interpreted by measurements and calculations, as is the case with "indicators" hitherto used; it shows on a dial the total amount of work done in the engine cylinder during any length of time that may be desired, be it a month or a week. To convert the dial units into foot pounds all that is wanted is to multiply by a number depending on the dimensions of the engine under test which, having once been found, becomes a consideration for all following experiments; the number of foot pounds divided by the time in minutes that the engine has run 33,000, gives the horse power developed. For *comparative* tests of fuel, lubricants, power absolved by different qualities of materials etc., no *calculation* at all is needed, the meter units affording all information required. To enable the action of the engine valves to be ascertained, a special attachment is furnished with the Boy's Meter, where a small power "card" can be taken in the usual way. No enlarging gears were used, however, as the small-sized diagram was sufficently large for the purpose, and being drawn directly by the meter piston rod must be more correct than when enlarged by means of parallel motion bars as in the Richards indicator. The interpreting mechanism, by means of which such great results are obtained is of the simplest possible description, consisting of two parts of a metal cylinder, 2 inches long and 1 inch diameter, and a small wheel about the size of a three-penny piece. These two parts are so mounted that the angular position of the latter, called the "tangent wheel," determines the amount of rotation of the integrating cylinder which is drawn passed it synchronously with the motion of the engine piston. The tangent wheel is kept in rolling contact, and is free to revolve on its own axis, its revolutions being recorded by means of a train of wheels and dial, with the intergating cylinder by means of a small spring and its angular position is produced by the meter piston rod as it is moved up or down by the steam or other agent employed to drive the engine. The instrument is attached to an engine in a similar way to the ordinary indicator than which it is, however more compact.

Its working parts are protected by a neat brass casing.

It is impossible without the aid of diagrams to explain the construction of the meter or enter into a consideration of the mathematical principal on which it is based, but to those who feel any interest in the subject, Mr. Boult will have pleasure in showing the instrument and furnishing any further particulars desired.

A meeting of the Society was held on the 13th of February, 1884, at the Royal Institution Colquett Street, Mr. R. R. Bevis, Jr., President, in the chair. When a paper on "The Strength of Bronze Alloys," was read by Mr. John S. Brodie, in which the various alloys of copper, tin, zinc, etc., were explained, and the various resistances to tearing, crushing, twisting, etc., stated.

Among the latest productions of bronze exhibited were phosphor bronze, manganese bronze, selicious bronze, and the various and successful application of the latter to telegraph and telephone wire purposes discussed. Selicious bronze wires have, it appears from experiments, all the tensile strength of high class wrought iron, with more than four times the electrical conductivity of the iron. This discovery will enable overhead wires to be made one-fourth the weight of wires now in general use, and greatly diminish the chances of accidents from the large net work of electrical wire conductors, now so familiar in all cities. The paper was illustrated by a number of samples of different kinds of bronzes, and an interesting discussion followed the reading of the paper. R. L. T.

CORRESPONDENCE.

PROBLEM IN GEOMETRY.

Special Correspondence Engineering News.

W. VA., CENTRAL & PITTSBURG R. R. CO., }
SHAW, W. VA., March 3, 1884. }

EDITOR ENGINEERING NEWS.—Is there any rule or formula for calculating the diagonals A. C. and B. D. in an oblique angled parallelogram, the lengths of the sides being known only? A SUBSCRIBER.

Special Correspondence Engineering News.

THE C. W. & G. RAILROAD AND TRANSPORTATION CO., }
WESTON, W. VA., Feb. 21, 1884. }

EDITOR ENGINEERING NEWS:—Enclosed I send some rules which I have found very useful in getting the data for calculating end areas, when we have the centre cuts and fills, and the surface slopes. Other engineers to whom I have suggested the method, have adopted it with a saving of labor, as assistants soon become very expert at getting out the quantities. I have made it as plain as possible, so assistants, to whom this part of an estimate is generally delegated, can understand the method readily. If you think it of sufficient interest please publish it. Yours respectfully.

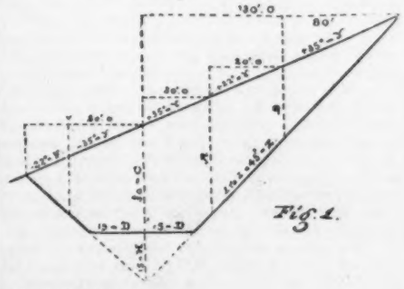
WM. A. PRATT, Chf. Eng.

Rules for Distance to, and Cut or Fill at Slope Stake from Surface Slope.

BY W. A. P.

When a road is located and an estimate prepared for the letting, it is of course desirable that the quantities should, as nearly as possible, agree with those which are made after the work is staked off for construction. The data which we generally have to work from, are the cuts and fills at centre, and surface slopes taken with the clinometer, and the custom is to use some of the published tables that give an approximation, or else when greater accuracy is required to plot the cross-section. The following rules were used by a brother engineer and myself in estimating for a location made several years ago, through a very rough part of south-western Pennsylvania. We found that the work could be done much more rapidly and accurately than by plotting, and we have used it ever since, and several other engineers to whom we suggested the method, have adopted it with a saving of time and trouble, and although the principle is very simple, I publish it, as it may not have suggested itself to some who would find it very useful in their work.

By having the surface slopes taken with care, the slope-stake might be set from these calculations. In slope-staking with level afterwards, I have found the agreement between the two methods to be remarkable.



C = Centre cut or fill.
D = ½ Road bed.
Y = Slope of surface.
Z = Side slope of cut or fill.
H = Perp. dist. to intersec. of side slopes.

Add to the centre cut or fill the perpendicular distance from road-bed to intersection of the side slopes of cut or fill obtained by multiplying the tangent of the side slope by ½ road-bed, or dividing half road-bed by ratio of the side slope to one—it is evident this distance will be a constant for each slope of cut or fill.

Then in a cut, if the surface slope is plus, divide this quantity by the difference between the tangent of the surface-slope and the tangent of the side slope of cut or fill, the result gives the distance from center to slope-stake. This known, the cut or fill at this point is readily obtained.

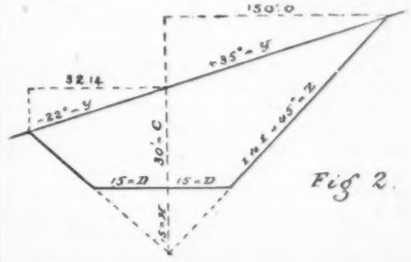
If the surface slope is minus divide by the sum of the tangents of surface and side slopes.

If in fills, do the adverse of this, viz: divide the centre fill plus constant H by the sum of the tangents of surface and side slopes if the surface slope is plus—and by the difference of the tangents if the surface slope is minus, or putting in shape of a formula it would be: In cuts when surface slope is plus or fills when surface slope is minus

$$\frac{C+H}{Tan\,Z-Tan\,Y}$$ using example above $\frac{30+15}{1.0-0.7}=150.0$

or in cuts when surface slope is minus, or fills when surface slope is plus

$$\frac{C+H}{Tan\,Z+Tan\,Y}$$ using example above $\frac{30+15}{1.0+0.4}=32.14$



If a change in the surface occurs between the centre and the slope stake, add to the centre cut or fill the constant H as before. Then, for cuts where the surface slope is plus, or fills where the surface slope is minus, multiply the distance to the first change of slope from the centre, by the difference between the surface and side slopes, and subtract that amount from the new centre cut or fill which gives A in the figure. Then using this as the centre cut, subtract from it the result of the difference of the tangents of surface and side slopes by the distance to next change, B in the figure, then divide this distance by the difference of the two tangents and the distance thus obtained plus the distance of the last change from the centre gives the distance to slope-stake.

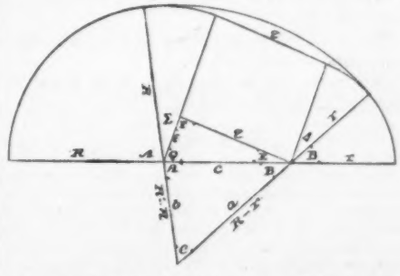
But in cuts where the surface slope is minus or in fills where the the surface slope is plus, do the converse viz: multiply the distance to change of surface by the sum of the tangents of the surface and side slopes and subtract it from the centre.

PROBLEM IN COMPOUND CURVES.

Special Correspondence Engineering News.

RAY'S HILL P. O., BEDFORD CO., PA., Feb. 26, 1884.

EDITOR ENGINEERING NEWS.—The following solution of the problem given in ENGINEERING NEWS of the 23, is given. S. H. CHAUVENET.



Given the radii R and r of two curves (in the same direction) and the length of the tangent (q) uniting them; to determine the angles (Σ and Δ) which it is necessary to take off of them to unite and compound them with an intermediable curve of the radius R.

Referring to the figure we find in the triangle ABC the sides are known; to find the angles we have by trigonometry.

$$Sin\ ½\ A=\frac{\sqrt{(s-b)(s-c)}}{bc}$$

$$Sin\ ½\ B=\frac{\sqrt{(s-a)(s-c)}}{ac}$$

$$Sin\ ½\ C=\frac{\sqrt{(s-a)(s-b)}}{ab}$$

In the right triangle EQF, the sides are known, find the angles Q and E.

Then $180°-(A+Q)=\Sigma$

$$180°-\left\{90°+\left(B+E\right)\right\}=\Delta$$

A WRITER in a contemporary journal says: "I discovered many years ago that wood could be made to last longer than iron in the ground, but thought the process so simple that it was not well to make a stir about it. Posts of any wood can be prepared for less than two cents apiece. This is the recipe: Take boiled linseed-oil and stir in pulverized coal to the consistency of paint. Put a coat of this over the timber, and there is not a man that will live to see it rot."

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 118*)

DCV. CLARION, PA.

Clarion, Pennsylvania, in lat. 41° 15′ N. long. 79° 20′ W., is on the Clarion River in a hilly region. Settled in 1839, it was incorporated a borough in 1840.

Water works were built in 1875 by a private company after plans of H. E. Rigley, taking the supply from the Clarion River, and pumping by a steam pump of 3½ in. bore and 14 in. stroke, constructed by Hubbard & Co., of Pittsburg, into two wooden tanks holding 48,000 gallons each, 59 feet above the town and 525 feet above the pumps. Distribution is by 2 miles of cast-iron pipe of 6 and 4 in. diameter, with 11 fire hydrants, 8 gates, and 140 taps. One meter is in use. The borough pays $110 per year for each hydrant. Service pipes are of wrought-iron.

The population in 1880 was 769. The daily consumption in 1883 was 40,000 gallons.

The capital stock of the company is $12,000. The works have cost $15,000. There is no debt.

The expenses of maintenance in 1883 were $1330 and the receipts $2480.

C. Kaufman is President of the company; C. A. Rankin, Secretary, and R. B. Thomas, Superintendent.

DCVI. ATHENS ASYLUM, O.

The Southeastern Ohio State Asylum for the Insane, in lat. 39° 30″ N. long. 82° 30′ W, was established in 1873 at Athens, on the Hocking River. The water supply was planned by Dean Stickney, and is drawn from a well 26 ft. in diameter and 27 feet deep, sunk in gravel 600 feet from the Hocking River. It is stated to be capable of yielding 48,000 gallons per hour. The water is pumped by a 9 in. steam pump built by Dean Bros., into a reservoir 150 by 50 feet and 6 feet deep, constructed in excavation and embankment, 150 feet above the pumps, and 100 feet above the Asylum. Distribution is by 1½ mile of 6 inch cast-iron pipe, with 22 fire hydrants.

The population supplied is 725. The daily consumption is not given.

The works are in charge of R. E. Hamblin, Steward of the Institution.

WATER.

WHAT THE NEW CROTON AQUEDUCT WILL COST.—The Aqueduct Commissioners met on February 20, and received from the Commissioner of Public Works an estimate of the cost of constructing the new aqueduct on the line of the modified Hudson River route. The estimate, the report says, is based on a rate of progress of 200 feet per month, that being understood to be the minimum rate intended to be required by the Commissioners. It is assumed that the tunnel for the aqueduct throughout its entire length will be in rock. The finished diameter of the aqueduct is taken to be 14 feet, and the diameter of the excavation 16 feet, with an allowance of one-third of a cubic yard in excess of that area for every foot in length, beyond which the contractor shall not be paid, unless otherwise provided for in the contract. This is equal to 7.75 cubic yards per lineal foot of tunnel. It is also assumed that the aqueduct shall be lined with an average thickness of three rings of brick, equal to 17.45 cubic yards per lineal foot, and that there will be a back filling of concrete of an average of three-tenths of a cubic yard per lineal foot.

The prices allowed are $9 per cubic yard for rock excavation; brick-work, $13 per cubic yard, and back filling of concrete, $5 per cubic yard. The cost of the shafts is included in the $9 per cubic yard, as the cost is but a very small fraction of the total cost of the tunnel. The above prices make the cost $94.01 per lineal foot; to this should be added the cost of hoisting in shafts. This is estimated at $1 per 100 feet. The total length of the tunnel to the Harlem River is 129,098 feet. Of this length four-fifths will be worked by shafts and one-fifth by portal. Calling the total cost $96 per running foot, then 129,098 feet will give a total of $12,393,408. Of this length 34,800 feet is the siphon line and that part of the line under the Harlem River, and though of less diameter than the main conduit, it may be expected to cost about $4 per lineal foot in addition, or $139,200, making the total cost of the tunnel conduit from Croton Lake to the north side of Manhattan Valley $12,532,608.

In addition to the above there are at Pocantico River crossing, 2,300 feet; at Jay Gould's swamp crossing, 1,000 feet; at Saw Mill River crossing, 4,000 feet, and at Tibbitts' Brook crossing 3,300 feet; making a total of 10,600 feet. Altogether there are 10,600 lineal feet of excavation for which the data at hand is not sufficient to enable a better estimate than, say, $141 per lineal foot, or about 50 per cent. in excess of the cost of the tunnel. The following is a recapitulation of the estimate:

Tunnel—Aqueduct from Croton Lake to north side Manhattan Valley	$12,532,608
Aqueduct in excavation	1,494,600
Gate-houses and appurtenances at Croton Lake	150,000
Waste weirs	150,000
Pumping Station, Harlem River	75,000
Gate-house, north side Manhattan Valley	75,000
Piping from above gate-house to Central Park Reservoir, including changes and connections with present mains and gate-houses; pipes to have capacity of 100,000,000 gallons per day	1,187,100
Total	$15,664,308

At several shaft locations there is the alternative method of working the tunnel excavation by adits, which, if adopted, would slightly modify the total estimate. It was thought best in the present case to make the estimate for work by shafts and portals only. A fair price for tunnel excavations at the rate of advance of 200 feet per month is a difficult matter to decide. There is really no guide from any work executed in this country applicable to the present case. It is believed that the price adopted, $9 per cubic yard, is as low as the work can be done for. This price was adopted after a conference with the chief engineer of the Aqueduct Commission, Mr. Church. All the prices, it is believed, are as low, or possibly lower, than the proper execution of the work will justify.

The report was received and referred to the chief engineer of the commission, with instructions to report any modifications or changes he may think desirable. —*N. Y. Times.*

THE Cunningham Iron Works of Charlestown, Mass., have erected reservoirs and water towers in the following places since 1874: Attleboro, Mass., 30′ diameter 40′ high; Haverhill, Mass., 30′ diameter 40′ high; New York high service tank, 8′x43′ 8″; New York high service stand pipe, 6′x150′; Newburyport, Mass., 40′ diameter 35′ high; Auburn, Me., 60′ diameter 18′ high; Peabody, Mass., 60′ diameter 25′ high; Long Beach, L. I. New York, 40′ diameter 11′ high; Warren, R. I., 40′ diameter, 35′ high; Alliance, Ohio, 20′ diameter 80′ high; Wyandotte, Kansas, 20′ diameter 75′ high; Quincy, Mass., 35′ diameter 60′ high; So. Abington, Mass., 20′ diameter 150′ high; Athens, Ga., 18½′ diameter 100′. They now have contracts for stand pipes at Woonsocket, R. I., 50′ diameter 30′ high; No. Attleboro, Mass., 40′ diameter 62′ high.

LONDON, (ENG.). WATER COMPANIES.—The government of London is a compound of anomalies, and a wonder of wonders is that Londoners should so long have submitted to occupy so low a position of inferiority in the powers of local self-government. They have been exposed to exactions which would have tried the patience and long-suffering of any other communities, and still the thing goes on. Take the question of their water supply, the attempt to deal with which had so much, or was assumed to have so much to do with the defeat of the late Ministry at the last general election and the return to power of the Gladstone administration. The case of London in respect of the supply, and consumption of water is peculiarly oppressive. There are eight independent companies which possess the right to supply water and to make charges under their legal powers, which expressed mildly, are extraordinary. They can charge a fixed price upon the rateable value of all houses, shops, warehouses, and other buildings, without regard to the quantity of water consumed. Inasmuch as the rateable value of houses in London has risen £4 per head in 1865, to £7 per head in 1882, and the consumption of water has remained the same, that is to say about thirty-one gallons daily per head of the population, the price paid was 75 per cent. more. The supply is also very inferior, the water being turned on for about half an hour each day instead of a constant supply. This system necessitates the providing of large cisterns to every building, which soon becomes foul, and the water in which, even where constant care is used in keeping them clean becomes stale and impure, exposed for twenty-four hours to the emanations from manufactories, stables, and the thousand and one sources of atmospheric impurities of large cities. The capital of these eight companies is about £13,600,000, and the charges for water averages seven pence farthing per one thousand gallons, of which the net profit is a little over four pence. The arbitrator who was employed in 1880 fixed the price at which these companies should be compensated for surrendering their monopoly at £33,000,000. Sir Joseph Bazalgette, the eminent city engineer, declares "that a purer and a more copious supply on the constant system, and at high pressure, is demanded, and each year's delay will only add to the cost and increase the difficulties involved." It is the opinion of those who are watching this aspect of the problem of London life that the intentions of the Government are to give the proposed reformed municipality full powers to deal with it without interference from the Legislature, save in the usual way of approval or disapproval, as when propositions from any locality are submitted to obtain powers to raise by loan or otherwise the necessary fund.—*Cor, Hartford Times.*

AN artesian well at Greeley, Col., struck water at a depth of 1,180 feet.

THE artesian well fever has struck Montrose, Col., and a test well is to be bored.

THE contract between the town of Franklin, Mass., and George H. Norman for the Franklin Water Company, has been signed. The company will begin as soon as possible to lay the pipes. The contract calls for fifty hydrants and one drinking fountain. Price, $2,700 annually for 25 years.

AN anonymous person pretends to have found a plumber's bill, running as follows: "Fixing up Smith's busted pipes, to wit: Going to see the job, $1; coming back for tools and help, $2; finding the leak, $1.50; sending for more help, $1.25; going back for solder forgotten, $1.50; bringing the solder, $1; burned my finger, $2; lost my tobacco, 50c.; getting to work, $3; getting my assistants to work, $2.50; fixing the pipe, 25.; going home, $2.50; time, solder, wear and tear of tools, overalls and other clothing, $5; total, $23.50."

THE Hyde Park Water-Works tunnel, near Chicago, which has now arrived at a point under Lake Michigan 3,145 feet from the shore, ran into a large "pocket" of sand and water, and operations were suspended.

A consultation of engineers was ordered, and their report submitted to the Board of Trustees was in substance as follows:

It is not feasible to continue the tunnel in its present course, owing to the nature of the obstacle encountered, which extends directly in front and to the south of its face. It is, however, entirely feasible to continue the tunnel on a course slightly deflected to the north.

In view of these facts they considered the following questions:

First—Has the tunnel already reached a point where a constantly pure supply of water can be obtained?

Second—Has it reached a depth of water sufficient to admit of the construction of a suitable inlet?

Third—Would a change of plan so as to shorten the distance between the tunnel inlet and the shore produce a popular distrust as to the quality of the water there obtained?

After considering the first question the engineers conclude that the advantages between 3,000 feet and 5,000 feet of tunnel are nearly equal.

In answer to the second question they state that the present depth of water, about twenty-five feet, is entirely sufficient, as it is but about three feet less than would be obtained at a distance of one mile.

As to the third question they sagely conclude that the water-supply is a question of vital importance. The engineers think it would be best to continue the tunnel to the length provided for in the contract.

THE annual rainfall in this country, according to the *Weather Signal*, is lowest in New Mexico (13 inches) and California (18 inches), and highest in Oregon (49) and Alabama (56). The annual rainfall in the British Islands among the mountains is 41 inches; on the plains 25 inches; 45 inches of rain falls on the west side of England, 27 on the east side.

NEW YORK'S new water supply will cost from $25,000,000 to $30,000,000. The works will be located in Westchester County, thirty-five miles from the city. A dam 250 feet high will form a reservoir of fifty-eight billon gallons capacity. New York City daily consumes 100,000,000 gallons of water, and when the new reservoir is completed the capacity for storage will reach 400,000,000 gallo s daily.

THE report of the Trustees of the Water Works of Bellefontaine, O., shows the total fund to have been $61,206.95, and the expenditures to have been $60,546.39, and the indebtedness to be over $6,000. Judge James Walker will present a bill for the Legislature to pass, authorizing the issuing of bonds in the sum of $25,000, but will have it embodied therein that the people shall vote whether they shall submit to the tax or abandon the works.

THE cost of maintenance of the Water Works of Peabody, Mass., was $6,027.34, and the interest account for the Water Works was $12,886.91. The receipts of the Water Board have been $22,972.42, and the net revenue beyond interest and cost of maintenance, $4,065.28. There has been 1,460 families supplied with water, an increase of 250. The number of new services was 148.

ST. LOUIS is looking after water waste, and in seven weeks has cut off 13,000,000 gallons, which was running to waste in the sewers from houses, hydrants and leaking pipes. This is a direct saving of the interest on an addition to the water works costing $1,250,000, and postpones the necessity of adding to the water supply besides.

A SURVEY has been made and active work will commence shortly on what will probably be one of the largest irrigating canals in the State of Colorado. The head of the ditch will be near Rocky Ford, east of Pueblo, and the ditch will run along the Arkansas River on the north side, gradually diverging until it passes La Junta, and continues until it reaches Sand creek. It is said that the canal will be seventy miles long and sixty eet wide at the bottom.

DANVILLE, PA., Mar. 8, 1884.

EDITOR ENGINEERING NEWS.—I send you following article as a matter of information for the public. The machine spoken of has been in use for 9 weeks in tapping the water mains of this borough and has given complete satisfaction. It has been adopted by 70 cities and towns throughout the country. Perhaps the article, if published in your paper, may bring out further information about other tapping machines in use, of which there are 8 or 10 to my knowledge.

Yours etc.,

O. H. OSTRANDER, C. E.

TAPPING MACHINES.—Among the devices for tapping water, gas and steam mains under pressure, the machine patented by John Sperring of Danville, Pa., may be mentioned as one combining lightness, durability and strength, at a minimum price. This machine will drill, ream and tap a main and insert a stop-cock or ferrule at one operation, without the necessity of removing the machine or of stopping off the supply in main or reducing the pressure, and the operation can be performed in from four to ten minutes of time. It is especially adapted to the high pressure or Holly system of water-works. No other tapping machine now in use contains as few parts to operate in the trench, or consumes as little in making a perfect tap.

ON Monday, March 3, the City Council of Freeport Ills., passed a resolution providing for a system of sewerage and employed F. E. Jasel, C. E., to make plans and specifications for the same at once, in order that active work may commence early in the spring.

MR. W. B. DAVIDSON, has resigned the position of Supt. of the Freeport Water Co. The works are now under the management of T. R. Sylvanus, Secretary and Treasurer.

THE Cleveland, O., Board of Water Commissioners, in their last annual report for 1883-84, state that the land and construction account for the new reservoirs and high service pumping station now foot up to $445,009.75. Contracts are already made for the completion of the work as follows:

Fairmount Reservoir, with McReynolds & Co.	$269,184.50
High service reservoir, with Freeman & Hall	120,291.05
New boiler house, with Uhl & Kostering	20,818.43
Three steel boilers, with Globe Iron Works	14,985.00
Main pipe, fittings, etc., with Silas Merchant	166,300.00
Pumping engine, with Henry R. Worthington	34,500.00

The amount of work which will be done during the present year is as follows:

Fairmount reservoir, estimated cost	$200,000.00
Kinsman street reservoir, estimated cost	110,000.00
New boilers	10,000.00
Main pipe under contract	60,000.00
Main pipe, to be laid under Kinsman street	70,000.00
Distributing pipe for low service district	130,000.00
Sub-mains and distributing pipes in the Eighteenth ward	50,000.00
High service engine house and engines	100,000.00

The total estimate for permanent improvements is $730,000; add to this, for the operating expenses and ordinary repairs, $75,000, making the total anticipated expenditures $805,000; deduct the estimated receipts for water, $290,000, leaving the estimate $515,000 for which bonds will be required.

H. J. STANLEY, Chief Engineer of the Cincinnati Board of Public Works, has made an elaborate report under date of March 5, upon a project to prevent future flood damages in that city. The chief end in view is the raising of the present river streets to a height above the highest water of Feb. 1884, and a strict adherence to this level in all future building. An estimate is subjoined for the raising of Main street only, at a cost of $47,316.37, and the expense of raising and underpinning houses, and filling present cellars, so as to bring the buildings to the proposed grade, at $78,500 for *one-half block*. From these estimates some idea can be formed of the total enormous cost of regulating the affected district. The report has been filed without definite action.

BIDS were received for excavating for the East side tunnel at Minneapolis on February 29, as follows: From J. O'Rouke & Hayes for $5,000; J. J. Palmer, $1,666 J. C. Lawrence, $2,961; John Burns, $1,287; C. Northburg & Co. and John Peterson, $1,276; Fred. C. Youngreen, $1,472; Simon J. Lynch, $1,980; S. C. Cutler, $2,275. Referred to the Committee on Extension, to report at the next meeting of the board.

BEFORE the Committee on Water Supply of the Massachusetts Legislature were heard petitions of persons for incorporation as the Housatonic Water Company in Great Barrington, with a capital of $20,000, and leave to take water from Long Lake; and of persons for incorporation as the Orange Water-Works in the town of Orange.

LIDGERWOOD MANUFACTURING COMPANY.—By the fire at the foundry in South Brooklyn, Thursday evening, February 28, the Lidgerwood Manufacturing Company lost only a small portion of the large amount of patterns belonging to them. The various newspapers in New York and vicinity reported the loss from $50,000 to $70,000, whereas the total loss did not exceed $6,000, the fire occurring in a room where, fortunately, very few patterns had been stored. The company lost no time in making new patterns, commencing the following day with a large force of pattern makers, and have, at this writing, made such progress that they will very shortly have new patterns equal to those that were destroyed. By the wise system adopted by this company of always keeping on hand a number of castings of the various hoisting engines manufactured by them, no delay has been occasioned in filling orders or building engines for stock.

NEWS OF THE WEEK.

Railroads and Canals.

THE contract has been let for building sixty miles of the Minneapolis & Sault Ste. Marie & Atlantic Railroad.

TWO CORPS of engineers are locating the line of the Junction City and Fort Kearney road from Lawrenceburg to Belleville, Ill.

IT is stated that $100,000 or more will be expended this season upon the Manchester and Reene Railroad. All of the wooden trestles now remaining will be either filled or superceded with iron structures, and various other improvements will be made.

IT is announced that a railroad will positively be built from Port Jervis to Milford, Pa., to be completed before December 31, 1884. The contracts are said to have been already made.

THREE miles of new track have been laid recently by the Pennsylvania Railroad running through valuable plants of machine-works and built-up portions of Philadelphia, which are said to have cost, including bridges, $1,250,000 per mile.

ARTICLE of incorporation were filed recently of the Cleveland & Western Railroad Company. This line is to be run between the city and Rocky River. The incorporators are Messrs. A. J. Wenham, A. J. Marvin, E. W. Laird, A. J. Marvin, E. W. Laird, A. K. Robibson, Charles E. Ferrell and T. M. Irvine.

THE Fort Smith & Sabine Pass Railroad has filed articles of association in the office of the Secretary of State of Arkansas. The road will begin at Fort Smith, and thence run southerly to Texarkansas, with privilege of extension to Sabine Pass, Tex. The distance between the two points is about 160 miles. Work will commence shortly. The capital stock is placed at $4,000,000.

THE Norwood & Montreal Railroad Company has filed articles of incorporation at Albany, N. Y., to build a railroad from Norwood, N. Y., to the New York State line in the town of Fort Covington, about forty miles. When completed, the road with its connecting lines, will form the shortest route from Niagara Falls or Syracuse to Montreal. The incorporators include Charles Parsons, William R. Grace, Edwin Parsons, Clarence S. Day and William Lummis, of New York; James Tillinghast, of Buffalo, and John D. Probst, of Fairview, N. J. The capital of the company is $500,000.

THE Northern Illinois Railway Company, with principal business offices in Chicago, and a capital of $2,000,000, was incorporated March 6, to construct a road from Belvidere, Ill., southward to a point in the Town of Hall, Bureau County, and a branch thence to Peru and La Salle. The incorporators are C. D. Devlin of Peru, and E. V. Holcomb, E. N. Saunders, M. L. Saunders, and H. Y. Smith, of St. Paul, Minn. The first Board of Directors are: E. N. Saunders, W. R. Marion, E. V. Holcomb, C. J. Devlin, Archibald Means, Henry J. Means, and W. E. Moore.

THE Elmira, Cortland and Northern Railroad was incorporated March 10. It is to run from Elmira, N. Y., to Canastota, in Madison County, a distance of about 120 miles. The capital is $2,000,000, in 20,000 shares of $100 each. The Directors are Austin Corbin, Islip; J. Rogers Maxwell and Henry W. Maxwell, Brooklyn; James Armstrong, Frederick W. Dunton, William G. Wheeler, Charles Bruff, Gilman S. Moulton, Thomas F. Ward, and John P. Dosh, New York; James K. O. Sheerwood, Oyster Bay; Archibald A. McLeod, Elmira; James D. Campbell, Davenport, Iowa.

THE Hon. William L. Scott, M. H. Taylor, and A. J. Cassatt are building a line of railroad which will open up to the North quick transit for fruits and vegetables from the South. This new line is being built down the Chesapeake Peninsula, along the eastern shore of the bay. The road—the New York, Philadelphia & Norfolk Railroad—is already built to Delmar. Erie capitalists bought a branch road, thirty-eight miles in length, from Delmar to Crisfield, and are now at work finishing the eighteen-mile stretch from Crisfield to Pocomoke City, and by April 1 it is the intention to have the road finished to Cherrystone or Cape Charles. The entire road will be ninety miles in length. At Cherrystone, or "Old Plantation," a ferry will transfer to Norfolk across the bay, thirty-six miles. The steamers will cost about $250,000 each. The cost of the road when completed will be about $2,000,000. This branch will connect the New York, Philadelphia & Roanoke Railroad with the Norfolk & Western and Seaboard & Roanoke. The General Manager is U. H. Painter, Philadelphia.

LAS VEGAS, N. M. is to have a railroad preserving works, and a railway hospital.

THE Hodges Pass Tunnel of the Union Pacific Railroad was finished on March 4. This tunnel is through the Unitah Range, is 1,440 feet long, and is near Twin Creek Station. P. N. Brintwall was the contractor, and Henry Rhoner, the engineer. It cost about $300,000.

THE stone abutments of the Ochs Ford Bridge at Verum, in Jennings Co., Ind., were built too far apart to receive the superstructure. Serious charges having been made by certain newspapers against the Commissioners, these latter have appointed a committee of investigation to find out where the blame is to be placed.

OTTAWA, Ont., March 3.—It is understood that a bill will be introduced in Parliament to authorize the extension of the Credit Valley Railroad from Woodstock to Sarnia, to connect with the Michigan railway system and give the Canadian Pacific connection with Detroit and Chicago.

THE Rapid Transit Commissioners passed a resolution yesterday, fixing the capital stock of the New York Cable Railway at $2,000,000, to be divided into 20,000 shares, at $100 each. Each subscriber will be required to pay up five per cent. of the par value of the stock at the time of his subscription.

THE Western Cable Railway Company of Chicago has been incorporated. The incorporators are Louis C. Wachsmith, Marvin A. Farr, and Edward L. Brewster. The capital stock is to be $1,000,000. The object of the company is to put in operation the United States Cable Company's system of Railways in various Western cities, as the new corporation controls that system in the West. It controls the Rasmussen endless cable system for propelling street-cars.

THE St. Paul and El Dorado Railway Company was also chartered recently. This line is to intercept the State line at the northeast corner of Washington County, and will run from thence in a southwesterly direction through said county and the counties of Harvey, Marion, McPherson, Saline, Ottawa, Cloud, Clay and Butler, to the town of El Dorado, in Bulter County. The length of the road in Kansas is 200 miles. The capital stock is placed at $18,000,000.

JUDGE HANCE has appointed Hon. Robert Martin, of Steubenville, O., receiver of the Cleveland, Youngstown and Pittsburg Railroad.

The road is finished from Nebo, Jefferson County, Ohio, to Phalanx, Trumbull County, on the Mahoning branch of the New York, Pennsylvania and Ohio Railroad about 100 miles.

THE Duluth, Fargo and Black Hills Railroad was incorporated March 5. The road will cross the Missouri River near Fort Yates, strike across the Bell Fourche or North Folk of the Cheyenne, and follow up Whitewood Creek to Deadwood. East of Fargo it will go by way of Leech Lake. The incorporators are Jacob Lowell, Jr., N. L. Shattuck, A. C. Bachelor, George Foley, J. C. Gill, J. B. Folsom, Gen. George P. Wilson, Samuel Mairs, J. W. Watson, W. A. Kindred and G. J. Kisner. It is understood that a contract for fifty miles of grading has already been let to contractor Foley.

THE *Winnipeg Times* says in regard to the present agitation in Manitoba and the demands made by the Legislature of the Province, that the Dominion had agreed to grant to a company for the construction of the Winnipeg and Hudson's Bay Railway a subsidy of 12,800 acres per mile. The Government has also appropriated $150,000 to provide for the survey of Hudson's Straits.

The distance from the Hudson's Bay coast to Liverpool is something less than from New York to Liverpool. The Dominion Government will also, in all probability, grant to Manitoba the proceeds of the sales of each alternate section of land in the Province yet unsold; and also of all the school lands at the capital.

THE Rapid Transit Commissioners of New York recently discussed the articles of association of the New York Cable Railway Company without reaching a vote. General Egbert L. Viele, chief engineer of the Board, presented a report of the practical workings of the cable railways in Chicago. The cable has been in operation there two years on the Southern, the Northern and the Western District Railways, and is doing the work of 2,500 horses, drawing 180 cars, and carrying 27,000,000 passengers yearly on 20 miles of roadway. The cable is one and a quarter inches in diameter, made of Swedes steel, has a hempen core and is com-

posed of six strands, each containing sixteen wires. The cable is warranted for two years and has now been in use for six months without any appreciable wear. The conduit is kept free from water and dirt that may pass through the slot by being connected with the street sewers every 450 feet, the bottom being graded to secure a perfect drainage.

The National Cable Railway Company has prepared a statement showing that the following annual expenses of running the trains on the present elevated railroad would be saved by operating them on the cable system:

Repairing roadway	$224,000
Repairs to engines and tenders	144,000
Engineers and firemen	505,000
Fuel	587,000
Engine dispatchers	170,000
Total	$1,630,000

There are 227 engines employed, weighing 37,400 pounds each. There are 6,000,000 miles traversed by the elevated trains yearly at a cost of $3,757,000. The cost of operating the Chicago cable road being 11 cents a mile, it is estimated that the distance traversed in this city by the elevated trains could be covered by cars drawn by cable for $660,000 a year. The cost of each locomotive on the elevated road is set down at between $5,000 and $6,000.

THE Chicago and Central Kansas Railroad has filed articles of incorporation with the Secretary of State of Kansas. The road is to run from White Cloud, Doniphan County, through the counties of Ottawa, Dickinson, Clay, Riley, Pottowattomie, Nemaha and Brown, to the town of Salina, in Saline County, which, the charter says, shall be the terminus. Its length will be 142 miles, and its adjacent branches will be 868 miles. The capital stock of the company is placed at $42,576,200. This is said to be an extension of the Burlington route, and a survey has already been completed for a bridge across the Missouri River at White Cloud to connect with the Chicago, Burlington and Quincy Road at Bigelow.

THE Beach Creek, Pa., Clearfield and Southwestern will be finished into the Clearfield region early in Spring.

THE Ohio River & Lake Erie Railway Company, which has already commenced the construction of a line up the towpath of the old Erie Canal from Greenville to Girard has decided to extend its line to Erie City. The engineer's corps, headed by Fred P. James, is running a line, leaving the original course at Lockport, and keeping south of Girard and Fairview, and will enter this city somewhere near the Coffin Works. It is the intention to run a line into the city and a branch to the lake. The enterprise is being pushed by Mr. W. W. Reed and others.

CITIZENS of Lambertville are endeavoring to secure the construction of a branch of the Philadelphia and Reading Railroad from that place to Hopewell, to connect with the Reading's Bound Brook line. The projected line will compete with the Belvidere division of the Pennsylvania. The Lambertville Common Council has passed resolutions favoring the project, and a public meeting is to be called to push it.

THE Canada Pacific Railway Company, according to statements recently made in the Dominion Parliament, issued upon its corporation 200,000 shares, or $20,000,000, of stock at 25 to the following persons: Geo. Stephen, 23,411 shares; D. McIntyre & Co., 19,509; J. S. Kennedy & Co., New York, 18,533; J. J. Hill, 19,509; R. B. Angus, 19,509; H. S. Northcote, 3,004; D. A. Smith, 19,509; Boisserain & Co., 1,950; Blake Brothers, New York, 975; R. Donaldson, 1,560; J. Tod, 1,365; D. James, 1,950; C. J. Osborne, New York, 1,950; O. H. Northcote, 390; Morton, Rose & Co., New York, 29,264; Bank Parisenne, 5,579; Lord Elphinstone, 1,950; W. C. Van Horne, 3,905; A. S. Lebau, 1,950; Cohen & Sons, 3,911; E. Grieninger, 3,901; Sulzback Brothers, 1,265; J. De Renach, 1,658; F. Ephrussi, 1,950. The amount of cash paid on account of this $20,000,000 was $5,075,075. The original syndicate, when formed into a company by act of Parliament, took $5,000,000 of the stock, paying par therefore. The balance was alloted to a syndicate, of which Wm. L. Scott, of Erie, was the head. Mr. Scott made a contract with the company to purchase $10,000,000 at 50 on February 1, 1883; $10,000,000 on June 25, 1883, at 52½, and 10,000,000 on October 25, 1883, at 55. Subsequently one-half of the latter $30,000,000 was purchased by a number of Amsterdam capitalists. Ten millions more stock were put up on a loan at 50, and $5,000,000 were disposed of at par.

The traffic receipts of the Canadian Pacific Railway in 1883 were $5,281,811, an increase of $2,648,391 over 1882. The receipts per mile open or traffic in 1883 were $2,598 against $2,203 in 1882.

THE last spike was driven on the Mexican Central Railroad on March 8, and there is now all rail route from New York to the City of Mexico. The Mexican Central starts at El Paso del Norte on the Rio Grande, and runs to the City of Mexico, 1,225 miles; it has been built in four years, at the rate of one mile per day. There is not a single tunnel on the line though it follows the backbone of the country, and the maximum grade is 80 feet to the mile. The only bridges of any consequences are at Eucarnacori, and at San Juan del Rio. The highest elevation reached is 8,135 feet, above sea level, 75 miles out of Mexico. The fare from El Paso to the City of Mexico is $60, $40 and $30, at first second and third class. The company are now building a branch road from Trapuato to San Blas, and another from Aquascalientes to the gulf, the latter will have a tunnel 290 feet long.

Bridges.

THE building of an iron bridge over the Miami River, California, O., has been approved by the Legislature of Ohio.

THE Morse Bridge Co. has received a large number of contracts to replace bridges swept away by the flood.

A NEW YORK syndicate has taken $200,000 of the bonds of the Henderson Bridge Company, and the Ohio River at Henderson, Ky., will be bridged and railroad connection be made continuous from St. Louis and Chicago to Nashville and points South.

THE heavy rains of March 8-9 have swelled the San Francisco River to such an extent that the iron suspension bridge on the Arizona and New Mexico Railway has been carried away, causing a loss of $25,000.

THE answer of the Pittburg & Lake Erie Railroad Company in the suit of the United States to compel the removal of the bridge at Beaver was filed in the United States District Court on March 7. Defendant denies that the bridge obstructs navigation, or that the United States has any power in the premises. The amount involved is nearly half a million dollars.

CLARKE, REEVES & Co., at Phœnixville, have taken a contract to build a new bridge over the Schuylkill at Poplar Neck, for the Wilmington and Northern Road, to replace a wooden bridge now in use. They are also building a bridge over Conowago River on the new Harrisburg and Gettysburg Road.

WHERE a municipal corportion does not use ordinary care and dilligence to make or keep a bridge over a ditch in one of its highways, whether constructed by it or not, a safe and convenient crossing for those using it as a passage over the ditch, both by day or night, it will be chargeab e with negligence and liable for whatever damages may be sustained in consequences thereof. Town of Belton vs. Vinton, decided by the Supreme Court of Georgia on the 19th ult.

HOW BRIDGE ACCIDENTS COME.—The Fairbanks testing machine, instead of testing only pieces cut from bolts, pillars, angle irons, etc., is built so as to admit the entire member to be tested. The *Engineering and Mining Journal* illustrates the obvious advantages of this by saying: "A well-known example of the desirability of this may be quoted from the experience of Captain Eads in the St. Louis bridge. Test-pieces of the steel bolts stood in the testing machine a stress of 90,000 pounds to the square inch. Some circumstances caused Captain Eads o suspect that the bolts themselves would not reach that quantity; and after building a testing machine especially for the purpose, it was found that the bolt broke at something like 40,000 pounds. If the St. Louis bridge had been built on the 90,000 pounds supposition, there would have been one more instance in the long catalogue of engineering disasters."

Streets, Drainage, Sewerage, Etc.

SCHENECTADY, N. Y., nearly the oldest city in the State, has no sewers. Typhoid fever, from contaminated well water, has lately caused the death or two citizens within 24 hours. The subject of sewers is now being agitated.

SALEM, Mass., wants a $150,000 sewer in the North River Basin; but the majority of Councils decided at the last meeting to appropriate $112,000 for filling up the basin and constructing a canal, instead of the sewer.

CLEVELAND, Ohio, is to build 1,000 ft. of main sewer on Madison Avenue, a relief sewer in Lena Avenue, and from 300 to 800 ft. of sewers in other streets. The work of street-paving is to be continued on Euclid Avenue, 6,400 ft. being yet unfinished. One mile of Broadway is to be paved, and more than one mile in length on Willson Avenue; a mile and a half on Superior Street is also to be finished this year.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Mar. 13, 1884.

The movement of Iron and Steel in this market for the past week has been slow in all except retail lots. Buyers are still apprehensive of a further decline in prices, and large requirements are accordingly withheld. There is a good deal of inquiry, however, and prices for the b tter makes of Iron are firmly held. Quotations for Pig Iron are unchanged at $20@$21.50 for No. 1 Foundry, $19@$19.50 for good No. 2, $17.50@$18.50 for Gray Forge. Bessemer is quoted at $20@$20.50. A large sale of a special make was closed on Monday at a little less than $22 at Philadelphia. Spiegeleisen is quoted at $29, but none is selling. Ferro Manganese is in active request at $44@$46. Steel Rails are selling at $34.50@$35 in 100 to 1,000 ton lots. Large lots would be taken at $34, but nothing less than that will be accepted. 40,000 tons have sold at Eastern and Western mills during the past week, and a great deal more would sell at a little less than quoted rates, but makers are firm, and as none of the requirements are urgent, buyers can afford to try what waiting will do for them. Crop Ends would sell in large lots at $19@19.50, but holders are asking $1 higher in most cases. Old Rails are quoted at $22.50@$23.50 for tees, and inquiry is active. Nails are quoted at $2.50@$2.60. Stocks of Scrap Iron of best quality are light. Bar Iron, 1.90@2c. for refined, and 1.70@1.80 for common. Demand active in small lots.

PITTSBURGH, Mar. 13, 1884.

The Western Pennsylvania iron trade shows a little improvement in some directions, as, for instance, in Nails, the production of which is increasing, and every indication pointing to an active Spring trade. Pig Iron is not in increasing demand, consumers having bought enough to last them some time, week before last, but for the small lots that are now being bought, prices are very firm, and a slight advance in prices for the best makes as confidently expected by the furnacemen. The two rail mills here are busily at work. The Edgar Thompson turned out 4,110 tons last week. Small sized lots of Rails are being ordered at $35@$36. The demand for Manufactured Iron is very dull, principally on account of the unfavorable weather. A few mills are working full time, but a good many are running single turn, with a reduced force. Bars are selling at from 1.70@1.90. Interest in the scale question is increasing daily, and the probabilities of a strike seem to be growing stronger. The green glass bottle manufacturers will probably all yield. Three houses have already started up, and the others are expected to follow suit. The window-glass houses are all busy, with plenty of orders on hand. Several of the glass blowers who went to Belgium for work have returned. The coal trade is improving; production of coke, 700 cars a day.

CHICAGO, Mar. 13, 1884.

There is a moderately good movement in all kinds of iron and steel, but the wintry weather, accompanied by numerous blockades through the Northwest, have been a great hindrance to trade, and the spring demand has not yet been presented. Prices for bars iron are rather steadier, and small lots are moving freely. Common bars are quoted at $1.90, and refined at $2.00. Tank iron is in good demand, but prices are weak at $2.50 to $2.60. Foreign irons are in light demand, and prices are weak. Lake Superior and Southern pig irons are in good demand. Furnace stocks are declining, and no stocks are being accumulated to take their place. Nails were in good demand, but the attempt of dealers to advance prices, has made purchasers timid. Quotations may now be given at $2.60 to $2.60, but the business done is usually at a shading from these figures. The ore market is moderately active. The hardware trade continues to improve. Carriage and wagon materials are in good request. Country dealers and blacksmiths are laying in supplies, shelf goods are active, for the season, and reports from traveling salesmen are encouraging. There have been no important transactions in steel rails, so far as can be ascertained. $36 to $36 are the prices asked for remote deliveries, while for prompt deliveries a little more will be asked. Stocks of wrought iron pipes have been offered at about 5 per cent. under combination rates, which have had an unsettled effect upon the market. Demand is light and irregular. The Union Foundry and Pullman Car Wheel Works at Pullman are starting work on the casting for 300 cars for the West Shore Road. This company have also large orders for passenger and freight cars on hand.

COAL.

The anthracite coal is quiet and only a moderate movement going on. There are large requirements waiting to be placed. Furnace coal, and the smaller sizes, principally chestnut and pea, are scarce, and in active demand. The Companies are stocking up at Western Lake ports, waiting for the opening of Lake navigation, and the prospects for a greatly increased Western trade are said to be fair. Production for last week, 460,473 tons, against 394,625 for the same week last year. Stock at Port Richmond has declined to about 100,000 tons. Circular prices are being shaded extensively, notwithstanding all the efforts of the companies to prevent it. Inferior coals are selling very low. There are no new features to report in the bituminous trade. The announcement of freight rates which will be made about the 20th inst. is looked forward to with great interest. Negotiations are still pending for the sale of large lots of bituminous in New England markets. Competition is so active, that contracts are being placed at ruinous rates, but this will go on, until the bituminous interests agree to combine.